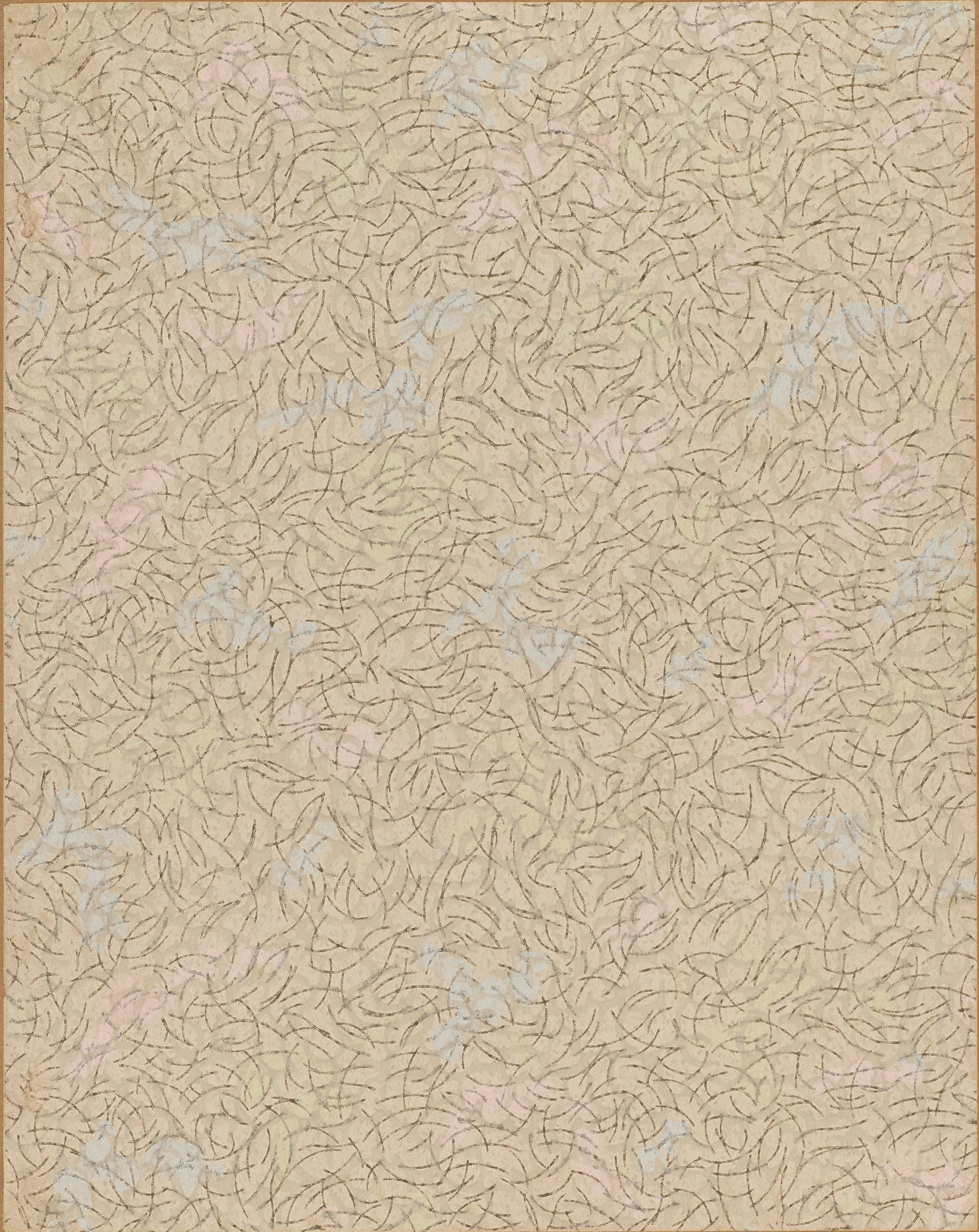




The Pteridophyta



1
Preface.

As a boy I was always eager to escape from the city (Chicago) into the country to hunt for ferns and flowers - but my main joy was in finding a fern.

When I was about 15 (1871) the family removed to Northern Wisconsin, and later to Madison and my real acquaintance with these plants began.

Literature on the subject was rare and almost inaccessible, so I early planned a book which should really help, and I had early arranged the following, long before the coming of Underwood's admirable work "How to know the Ferns."

I owe most of my help and encouragement of those early days, to Miss Susie Williamson botanist of the University of Wisconsin.

St. Cloud, Florida, 1930

Mabel Cave, Mo. 1935

The Pteridophyta
a Companion to the Study of the
Ferns.

Always was I deeply interested in ferns, but knew little about them until about 1879 I drifted into a little group of fern lovers who kept in touch with each other by letter. They were as widely separated as Miss Kallfleischer in Long Island, New York; W. N. Clute, Joliet, Illinois, and Laura Kimball, National City, California.

Fern literature was not as voluminous as at present, yet I was constantly at a loss in my study, because of the number of names applied to some of the species.

Then I realized that there was but one way out—An Index List of the Ferns of the United States and Canada, and a Synonymy.

The Libraries of Chicago and Cleveland, and later, of the University of Illinois, enabled me to bring the work up to 1925.

Our little Correspondence group grew up into the Fern Chapter, then the Fern Society, and their members and publications formed the base of the work.

I have found it invaluable—indispensable in my studies,

Introduction.

The Pteridophyta, or Vascular Cryptogamia, includes all the Cryptogamia which possess a distinct vascular system, and consist almost entirely of chlorophyll-bearing plants, which are never parasitic.

In some of the species there is as great a differentiation of tissues as in the seed-bearing plants.

There is a distinct alternation of generations—the sexual generation, or gametophyte (prothallium) and the asexual generation, or sporophyte produced by it.

The gametophyte is developed outside the spore-coats, tho in certain of the highest members of the group, it scarcely emerges from the spore. It is a thalloid structure, usually minute and delicate, in most of the groups containing chlorophyll, and developed above ground. It produces the female element (archegonia), and the male element (antheridia).

The asexual generation arises from a fertilized oosphere in an archegonium. The young sporophyte secures its first food from the prothallium thru the foot, the first outgrowth of tissue from the oospore, and develops into a highly organized plant, having stems, leaves, and usually, true roots. Only a few species are annual.

The first part of the stem, and the first roots and leaves are very small, and usually remain so, the later ones becoming successively larger and more complex, until the new organs are similar to the specific type.

The stem, or rhizome, grows indefinitely from an apical bud, and at first branches dichotomously. It eventually dies at the older end, and the dying zone, advancing at a slower rate than the apical growth, detaches the branches, leaving them as independent plants. The growing end may be far in advance of the youngest leaves, or its growth may be so slow that its apex remains enclosed in the advancing leaf-bud.

The leaves, or fronds, arise from the rhizome in a certain definite spiral order peculiar to each group, and are characterized by a circinnate vernation, only unrolling in the last stage of their development, and by an indefinite growth from an apical cell. The rachis, the continuation of the stipes thru the lamina or blade of the frond, and the lateral veins are curved from behind forwards. The leaves show a great variety in their size and branching, this being being very constant in each group.

The sporophylls, leaves especially modified for the purpose, produce sporangia which bear the spores from which the gametophyte is developed.

The roots grow in length from a single apical cell, but generally remain an even width throughout. They spring from the pericambium just in front of a xylem ray, and grow acropetally from the bases of the stipes. Their branching may be dichotomous or monopodial. The primary root never develops as a tap-root.

The differentiation of the various systems of tissues is highly perfected, and the epidermis, fundamental tissue, and fibro-vascular bundles are clearly distinct. The fibro-vascular bundles are closed, and consist of a mass of xylem completely enveloped by a layer of phloem.

Within each group the characters of the various parts and organs are so constant that they form a most natural and reliable means for classification and recognition.

The Pteridophyta falls naturally into two great divisions - those producing but one kind of spore, the Isosporae; and those producing two kinds of spores - the Heterosporae.

The Isosporae produce but one kind of spore. The prothallium grows for some time independent of the spore, and produces both the male and female elements.

5

It comprises the Equisetineae

Filicinaeae

Ophioglossaceae

The Heterosporae produce two kinds of spores — macrospores, developing the female element; and microspores, developing the male element.

The prothallia are never separate from the spore, and draw their nourishment from it.

It comprises the

Lycopodiineae

Ligulatae

~~These~~ ^{subdivisions} are again subdivided into Orders, Tribes, Genera, etc.:

Orders. Under each Class, those ferns which are distinguished from each other principally by the method in ~~in~~ which the sporangia are developed are grouped into Orders.

Sub-Orders. According as they differ in the character of the sporangium — its shape, methods of discharging its spores, and the existence, character, or absence of a ring, are collected into Sub-orders.

Tribes. The position and arrangement of the sporangia in clusters, or sori, or resemble each other in mode or habit of growth, further divides them into Tribes.

Genera. The arrangement of the sporangia on the veins, and the character, position, and shape of the indusia, divide the Tribes into groups called Genera.

Sub-Genera. Under each genus those ferns resembling each other, either in venation, or the cutting of their fronds, or in both, and differing in other respects, form Sub-genera, or §

Species. Agreeing in the cutting of their fronds and their method of venation.

Varieties. Small, but constant, variations from specific type.

There is one Order in the Equisetineae, three in the Filicineae, and two in the Lycopodineae:—

Sporangia produced in groups on the margins of metamorphosed leaves, forming peltate scales, and constituting a terminal fructification Equisetaceae

Sporangia reticulated, homogenous with leaf-hairs, or trichomes, being formed of epidermal cells. Filices.

Sporangia large, placed singly on lateral veins of the pinnae, to which they are attached by a narrow, ridge-shaped base or pedicel; ringless, coriaceous, more or less confluent into a lobed mass Marrattiaceae

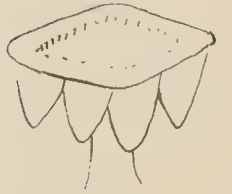
Sporangia formed of the interior tissue of the frond, not reticulated, on a branch of the leaf, constituting a spike or panicle, naked, destitute of a ring, opening into two halves by a transverse slit Ophioglossaceae

Sporangia ^{formed} from a metamorphosed leaf or foot-stalk, divided by septa, or unilocular Rhizocarpeae

Sporangia formed in the axils of leaves of the ordinary form, or of others somewhat modified, forming spikes at the ends of the branches Lycopodiaceae.

Sub-Orders:

Sporangia one-celled, opening down the inner side,
adhering to the angled, shield-shaped scales of spike Equisetaceae



Sporangia with a transverse, or oblique, complete an-
nulus, bursting with a longitudinal slit, borne on a pro-
longation of the fertile vein (columnella), projecting be-
yond the margin of the leaf ----- Hymenophyllaceae



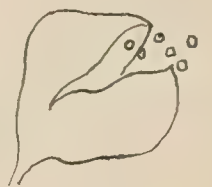
Sporangia ovate, sessile, opening longitudin-
ally; ring complete, transverse ----- Gleicheniaceae



Sporangia ovate, or ovoid, in spikes or panicles;
ring complete, transverse, apical, or cap-like;
opening longitudinally ----- Schizeaceae



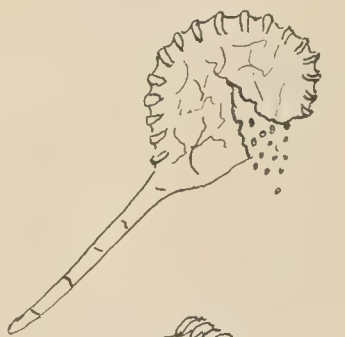
Sporangia short-stalked, unsymmetrically globose;
ring a mere trace of thickened cells on one side near
near the apex; opening on the opposite side longi-
tudinally ----- Osmundaceae



Sporangia with a complete, eccentric, oblique ring;
opening transversely ----- Cyathaceae



Sporangia pedicelled, surrounded more or less com-
pletely, by a jointed, vertical, elastic ring, straighten-
ing at maturity, bursting the sporangium trans-
versely ----- Polypodiaceae



Sporangia globose, not collected into sori, ring very
broad, flattened, nearly complete, or imperfect, or obsolete. Cera topterideae



Tribes:

Sporangia solitary, or in pairs, in the axils of large
scale-like indusia ----- *Lygodiaceae*

Sporangia large, vertically sessile, in two rows, .
either side a single vein ----- *Schizaceae*

Sporangia spread in a stratum over the whole
under surface, or both surfaces ----- *Acrosticheae*

Sori occupying the whole length of the veins, or
special branches of them, or the back, or the thick-
ened end of a vein ----- *Polypodiaceae*

Sori dorsal, variously arising from the veins,
usually linear, ----- *Grammitideae*

Sporangia borne in a furrow ----- *Vittariaceae*

Sori linear, linear-oblong, or globose, mostly marginal *Pteridiaceae*

Sori dorsal, linear or oblong, on veins parallel to
the midrib ----- *Blechnaceae*

Sori dorsal, linear, or oblong, oblique to midrib. *Aspleniaceae*

Sori round or roundish ----- *Aspidiaceae*

Sori at ends of veins, or on marginal cross-
veinlets ----- *Dicksoniaceae*

The Isosporae

The Equisetineae.

Plants with slender hollow, jointed stems, and minute, scale-like leaves more or less adherent, forming sheath-like bands at the nodes. Sporangia borne in spikes.

The spores lose their vitality in a few days. After the first phases the growth of the gametophyte is very slow. It is green, above ground, and is irregularly lobed and branched, becoming thick and fleshy, with root-hairs on the ventral surface. It is dioecious, the male remaining quite small, and may produce archegonia on shoots of later formation. The female prothallia are larger, and produce antheridia at first, archegonia much later which are fertilized by antheridia from other prothallia.

After fertilization of the oosphere, the first leaf-bearing shoot grows upwards and forms from 10-15 internodes with 4-toothed sheaths, which produces new generations of shoots, developing constantly. Thicker stems and sheaths with more teeth. Some one of the succeeding shoots grows downwards into the ground forming the first rhizome, which produces, from year to year new underground rhizomes and ascending leafy shoots.

The branches spring from within the base of the leaf-sheath, and are verticillate;

the roots originate from beneath the bud for each branch, this rule holding good for each whatever the modification, whether into rhizomes, tubers, ascending stems, leafy branches, or sporangiferous stems.

The sporangia are generally formed in whorls at the summit of special stems, forming a spike of peltate, hexagonal scales bearing the spores on their inner surface.

When ripe, the outer coat of the spores breaks up into two bands fastened at their center, and are wrapped spirally around the spore. These "elaters" are very hygroscopic, and unroll when dry, rolling up when moist with every slightest change in the air, setting the spore in motion by their rapid movements.

Hymenophyllaceae.

Rhizomes creeping, filiform. Fronds thin, very delicate, pellucid, much divided. Sporangia sessile around the base of a brittle-like prolongation of the veinlet, which continues its growth beyond the vase-like, cup-shaped, or two-lipped indusium. Ring transverse or oblique, complete.

Schizaceae

Small ferns with linear sterile leaves, tortuous or "curly", and taller fertile fronds bearing the sporangia at the top.

Fronds slender, climbing, or twining by its flexible rachis, with paired, palmately-lobed pinnae, the uppermost fertile, contracted, forming a panicle, the segments bearing the sporangia in double rows. Ring transverse at the summit; complete.

Osmundaceae

Sporangia naked, on the margins of very much contracted, rachis-like divisions of the sporophyll. Fronds tall, from thickened, creeping rhizomes. Ring obscure; stipes flattened, and winged at the base. Prothallium long and ribbon-like, producing archegonia from both sides of a midrib extending thru it from base to apex. Antheridia spring partly from the margins and partly from the ventral surface, excepting the midrib. The gametophyte produces shoots or branches on the margins which may become detached and function as vegetative organs of reproduction. The prothallia show a tendency to become dioecious, all the spores from one sporangium sometimes producing antheridia only, at first, the archegonia later, fertilization being by antheridia of other prothallia.

Polypodiaceae.

The gametophyte is above ground, green, monoecious. It consists of a single layer of cells and resembles the thallus of a Hepaticae. It develops into a broadly cordate or reniform structure, with the apical cell at the bottom of the sinus. Numerous root-hairs are formed on the posterior ventral portion, and it may continue to grow indefinitely. It produces both antheridia, male, and archegonia, female, on the ventral surface. — the former among the root-hairs, the latter near the base of the sinus. The gametophytes show a tendency to become dioecious tho there is but one kind of spore.

The rhizome mostly creeps along the surface, or close to the surface of the soil, among lichens, mosses, dead leaves, etc.; and may grow on ledges and in crevices of rocks; or on decaying logs, and stumps; and in any direction; perpendicular, ascending, horizontal, and is seldom subterranean.

It may be woody, fleshy, knotted, cordlike, or thread-like, and is usually covered with the persistent bases of the fronds. It branches, at first, dichotomously.

The roots grow acropetally from the bases of the leaf-stalks, springing from the pericambium layer just in front of a xylem ray.

Generally, they are numerous, wiry, thread-like, and grow by the division of a single apical cell.

The leaves are of two kinds, vegetative, or sterile, and fertile, the sporophyll, which bears numerous sporangia which develop the spores. They may be simple, or variously branched or divided. They arise from the rhizome in a regular spiral succession, their stem or stipes curving or twisting to bring the blades into proper position. The sterile fronds always precede the fertile, tho they may also be produced continuously, coming before and after, as well as with them. The sporophylls are usually the larger, more modified, and numerous. In some species the fertile frond is very similar in appearance to the sterile. It may be sporangiferous from base to tip, or the sporangia may be confined to some definite portion of the frond, which part may be greatly modified; the fertile fronds may be produced alternately with the sterile, or in groups.

The trichomes are produced in a great variety of forms and positions. Root hairs arise not only on the roots, but on rhizomes and bases of stipes. Numerous flat, multicellular hairs, palea, occur on rhizomes and stipes, often enclosing leaf-buds. Long, strong bristles and frail delicate, articulated hairs are sometimes found on the lamina.

The sporangia are also trichomes of the leaves.

They are stalked capsules in which are formed the spores. A ring, or partial ring of thickened cells, the annulus, causes the sporangium to burst open and liberate the spores when ripe. They usually arise from the epidermis of the veins, on the ventral side of the lamina. They are generally combined into groups, sori (sorus) of various sizes and forms. With the sporangia there are usually slender, articulated hairs, the paraphyses. The sorus may be seated ⁽¹⁾ on the end of a vein, ⁽²⁾ in the angle formed by two branches, or ⁽³⁾ on the back of a vein.

These fertile veins may be like the sterile or may be variously modified. They may be swollen and form a receptacle for the sorus, or may project beyond the margin of the frond.

The spores contain chlorophyll and other contents besides the nucleus. The wall consists of an endospore of cellulose and an exospore covered with scales, ridges, etc. The spores of many species are notable for the long period they retain the power of germination, and by the slowness of this process. In some species they germinate while still in the sporangium.

The sori are often covered by an outgrowth of the epidermis - the indusium, which is generally of the same shape as the sorus. It may be elongated, or round, cordate, kidney-shaped, hood-shaped, star-shaped, cup-shaped, etc.

Ophioglossacea.

Somewhat fleshy plants, the leaves erect or inclined in veneration. Sporangia in special spikes or panicles. Prothallia underground, monoecious. Stem subterranean, never branching. (?) Roots thick and fleshy, rarely branching.

Ophioglossum.

The gametophyte resembles a minute tuber. It produces antheridia in cavities over its whole surface, archegonia on the lower surface. The leaves arise at the base and just in front of the one preceding. (In O. vulgatum, the phyllotaxy is $\frac{2}{5}$). The fertile leaves develop a branch from the axial side, which bears a two-rowed spike of sporangia. Both sterile and fertile fronds are otherwise simple and unbranched. Large colonies of this fern are sometimes connected with a thick tough, subterranean stolon. (O. 1).

Botrychium.

The gametophyte is ovoid, monoecious, and sparsely covered with root-hairs. It produces antheridia in cavities on the upper surface and archegonia on the lower. The leaves have a sheathing base which enclose the next younger leaf; the apex of the stem is deeply buried in the youngest. The fertile leaves bear a branch on the axial side, which bears the sporangia in simple or compound spikes, or in panicles; the sterile branch and fronds are simply incised to more or less deeply compound. The development is extraordinarily slow in this group.

The Genera:

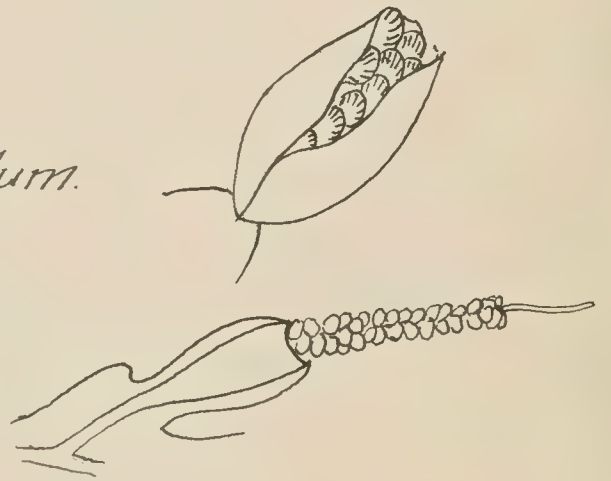
Sporangia 6-7, adhering to the underside of angled, shield-shaped scales of a terminal spike ----- *Equisetum*. L

Sori marginal, in the sinus of the teeth or lobes, terminating a vein, declined; involucre sub-urceolate, coriaceous, the mouth truncated, entire. Receptacle elongated, much exerted, clothed to the apex with stipitate capsules which have a broad, incomplete, oblique ring; opening vertically. Caulis long, stout, creeping, paleaceous; fronds long-stipitate, coriaceous, decomposed, glaucous beneath; veins simple or forked. ----- *Loxosoma*. Br.



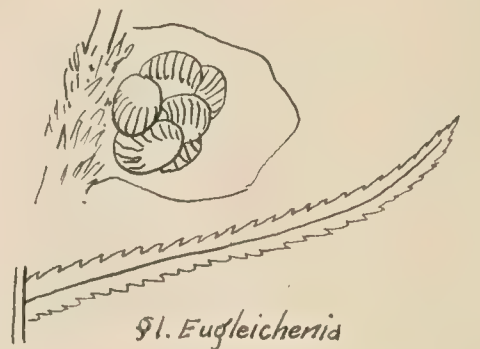
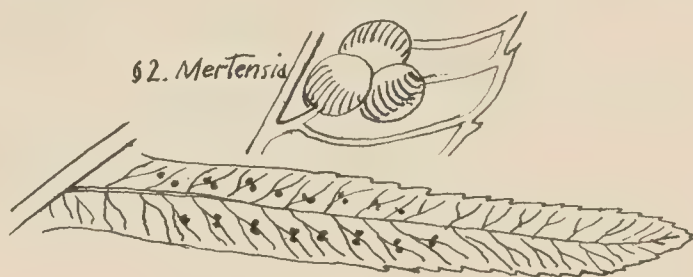
Columnella short, included; indusium two-valved. *Hymenophyllum*.

Columnella partly exerted, indusium tubular or funnel-form, entire or two-lipped at the mouth. *Trichomanes*



Sori of a few sessile capsules on the apex of simple veinlets, covered by the revolute margins of the pinnae. Caulis creeping, stipites tufted, fronds 8"-1' long, pinnated with small, coriaceous, cucullate pinnae *Platyzoma*. Br.

Sori punctiform, naked, non-indusiate, superficial, or immersed, with few sporangia which are sessile, at the apex of an exterior veinlet; veins simply or pinnately forked, venules free ----- *Gleichenia*. Br.



The Genera:

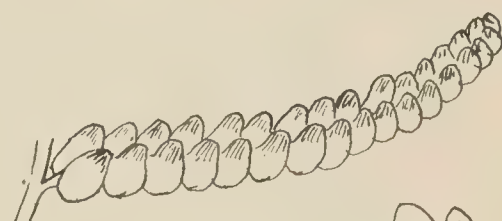
Sporangia solitary, or in pairs, in the axils of large, imbricated, scale-like indusia, which are fixed by their bases to short, oblique veinlets ----- *Lygodium*



Sporangia naked, in two rows on the back of very narrow branchlets ----- *Aneimia*.



Sporangia large, vertically sessile in two rows along the single vein, on the back of narrow divisions of the fertile portion of the frond ----- *Schizeae*



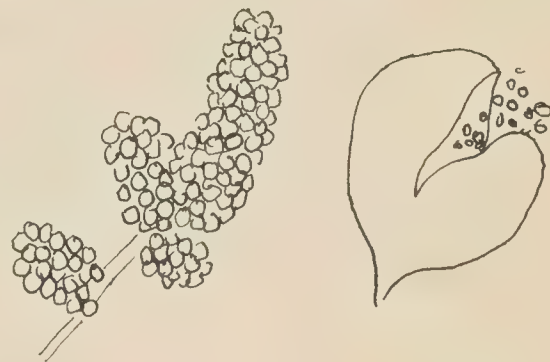
Sporangia sessile, almost globose, opening vertically on their inner side, facing a border of rounded prominences along the edge of the underside of the frond; veins free; fronds bipinnate, pinnae entire, fertile one contracted ----- *Mohria Swz.*



Sporangia small, sessile, placed irregularly round the edge on the underside of the slightly contracted lower lobes of the leafy frond ----- *Trochopteris Gardn.*



Sporangia short-stalked, naked, on the margins of the rachis-like divisions of the fertile fronds, or fertile portions of fronds ----- *Osmunda*



The Genera:

Todea. Willd.

§1. *Eutodea*. Sori naked, sporangia hypodermous; veins forked; venules free; fronds coriaceous; bipinnatifid, fertile ones sub-contracted.

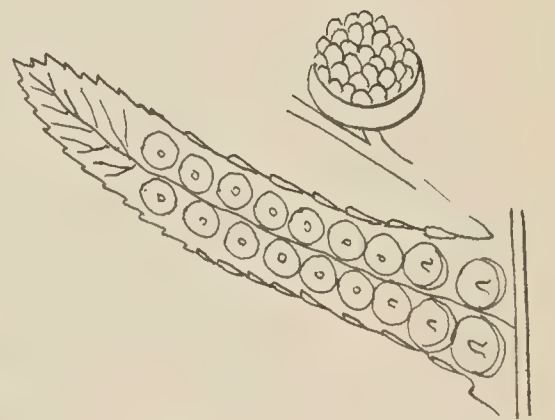
§2. *Leptopteris*. Sporangia on the veins, not forming distinct sori; fronds translucent.



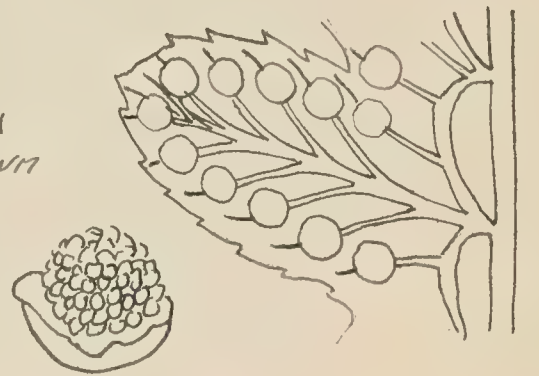
Sori on the ends of the veinlets; involucre coriaceous, cup-shaped, entire, petiolate; veins pinnate, veinlets free, their ends forming soriferous pedicels; fronds decomposed-multifid, with the fertile portion contracted and paniculate.

Thyrsopteris
Kuntze

Sori globose, intramarginal, axillary at the forking of a vein, or medial; sporangia usually sessile on an elevated receptacle; indusium globose, membranaceous, completely cup-shaped, at first covering the whole sorus; veins forked, venules free. — *Cyathea*



Sori solitary, globose, medial or axillary; receptacle elevated, globose; indusium semicircular, concave; veins simply or pinnately forked, venules free; the veins mostly angularly anastomosing, forming a costal arch; fronds large, arborescent. *Hemitelia*
Brown



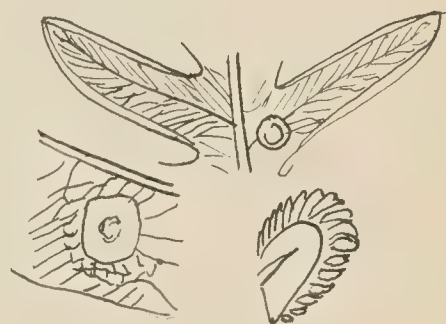
The Genera:

Sori globose, axillary or medial; receptacle elevated, often villous; indusium frequently obsolete, or perhaps none; veins simple or forked, free; fronds bi-tripinnatifid, 5°-15° long, Erect and arborescent ----- *Alsophila*.
Al.Br.

Sori globose, the receptacles small, scarcely elevated; involucre inferior, globose, hard-membranaceous, entire, at length bursting very irregularly at the summit; capsules numerous, nearly sessile; ring broad ----- *Diacalpe*. Bl.

Receptacle of sori expanded into a firm-membranaceous, umbrella-shaped, obscurely 6-lobed, stipitate involucre, which covers and encloses 6 large sessile capsules; veins forked, free, except those around sori, which are closely reticulated; not arborescent ----- *Matonia*. Br.

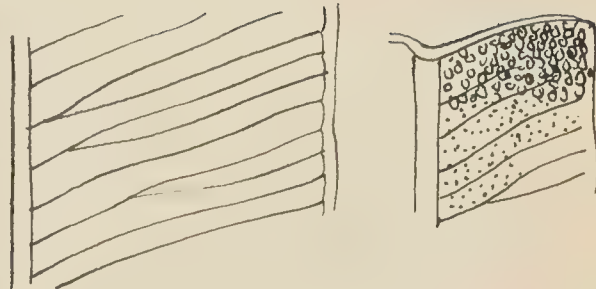
Sporangia seated on the veins, veinlets and parenchyma; sori naked, occupying the whole inferior surface, or, in a few cases, the upper surface also; venation and cutting various ----- *Acrostichum*.



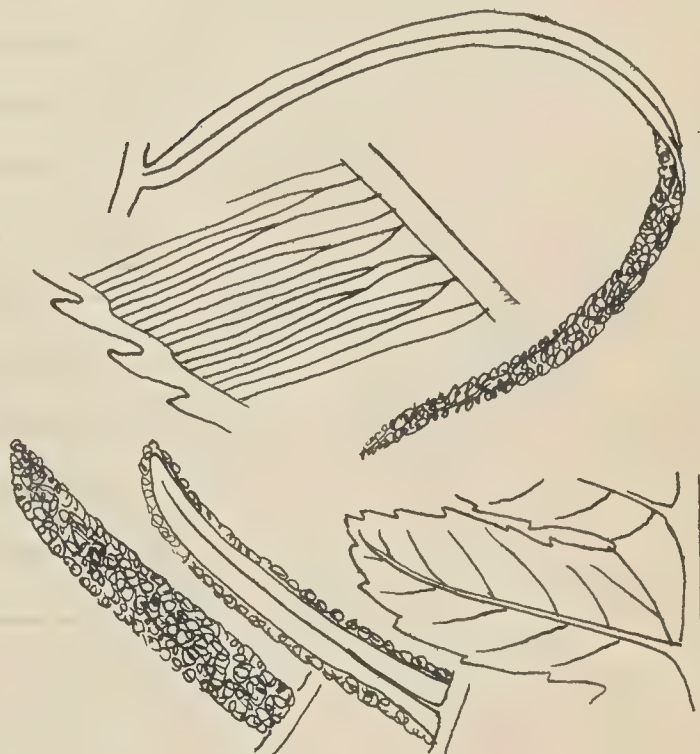
The Genera:

Acrostichum

§1. *Elaphoglossum*. Fronds simple, oblong, or linear-lanceolate, veins simple or forked, veinlets parallel, their tips free and clavate, terminating in a thickened margin. *Conformis*.



§2. *Sternochlaena*. Petioles articulated with the rachis; most of the species climb the loftiest trees by means of their stout rhizomes. Fronds differ in different parts of the plant.



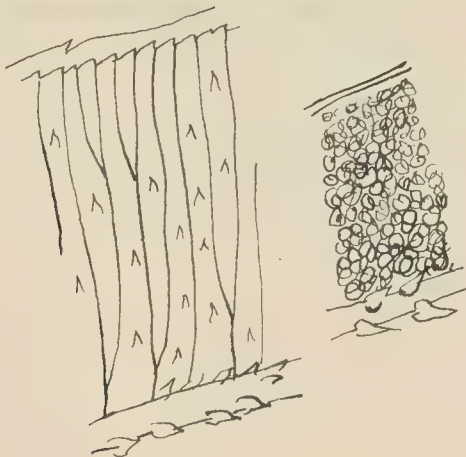
§3. *Polybotrya*. Veins pinnate, venules simple, free, external; fronds bi-tri-pinnate.

§4. *Egenolfia*.



§5. *Rhipidopteris*.

§6. *Aconiopteris*.



The Genera.

Acrostichum.

§7. *Olfersia*. Fronds pinnate and bipinnate; veins direct, simple or forked, their apices connected by a transverse marginal vein; sori densely covering back of fertile fronds, or both sides.

§8. *Stenosemia*.

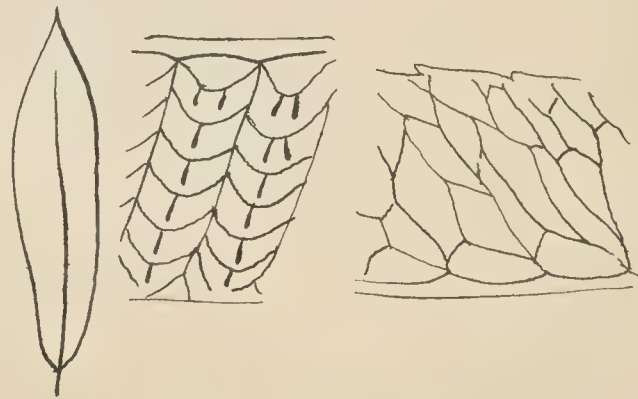
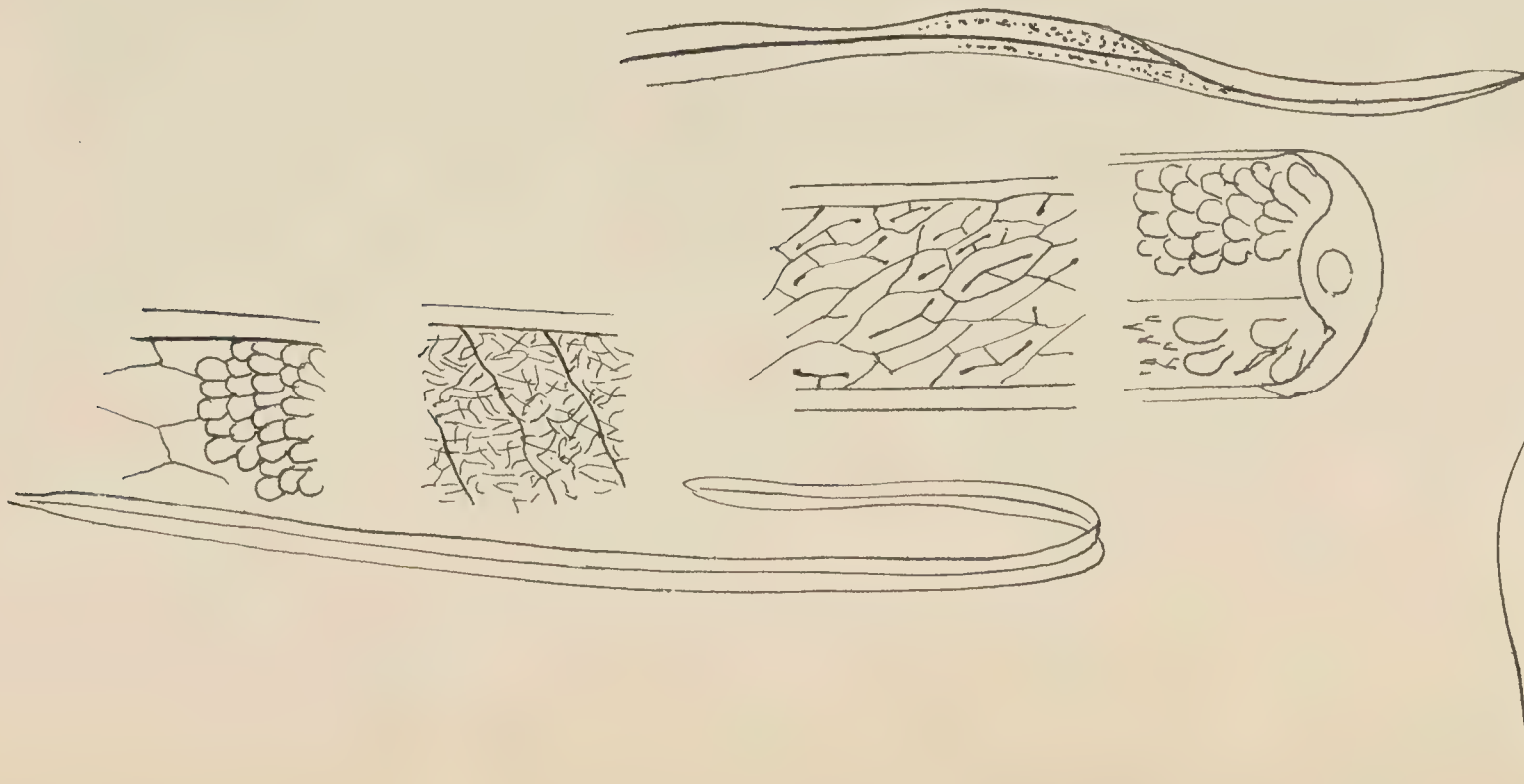
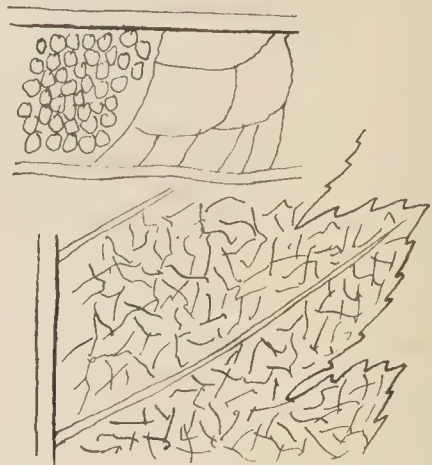
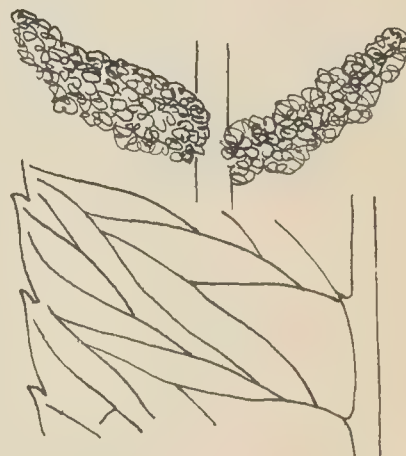
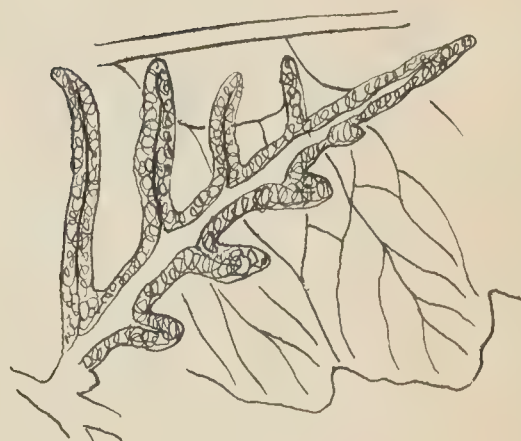
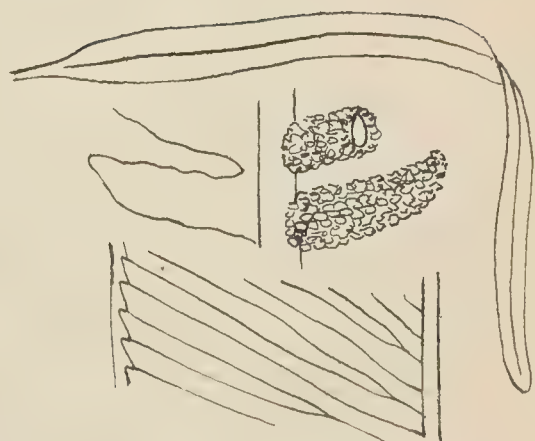
§9. *Soromanes*.

§10. *Gymnopteris*. Veins pinnate, venules compoundly anastomosing; fronds simple, lobed, or pinnate.

§11. *Chrysodium*. Fronds coriaceous; veins reticulated; sporangia widely diffused, but confined to the under-side. *Aurum*.

§12. *Hymenolepis*.

§13. *Photinopteris*.



The Genera:

Acrostichum

§14. *Poecilopteris*. Venation pinnate; pinnules arcuately, or angularly anastomosing; fronds pinnate.

§15. *Lomariopsis*. Veins uniform, simple, or forked; fronds pinnate.

Fronds simple, forked, coriaceous, thick, spongy, dimorphous, the sterile ones sessile, permanent, successively imbricated, depressed or ascending; sporangia on fertile fronds mixed with stellate scales, in orbicular, or subcordate, patches. Whole surface of frond covered with a stellate pubescence; veins repeatedly forked, and distantly anastomosing; venules internal, compoundly reticulated, with free veinlets terminating in the areoles. Epiphytic. (*preh-platys*, broad; *keras*, a horn). -----

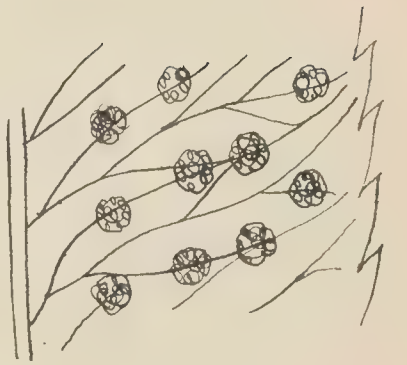
Platynerium.
Desv.



The Genera:

Sori round, naked, dorsal, in one or more rows, occupying either the whole length of the veins, or special anastomosing branches of them, or the thickened end of a vein -- *Polypodium* L.

§1. *Cyrtomphilebium*. R.Br. Veins forked or costaeform, pinnate, lower exterior venule of each fascicle free and fertile, the rest arcuately or angularly anastomosing; sori distinct, round, naked, in two rows between and parallel with the veins, or irregular; sporangia lateral or terminal; fronds smooth.



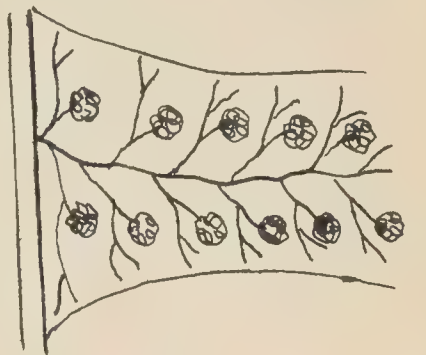
§2. *Goniopteris*. Veins costaeform, pinnate, the lower ones anastomosing angularly; sori circular, usually placed on or near the middle of the venules, or basal, or sub-terminal; sporangia hispid; spores rough.



§3. *Dictyopteris*. No free veinlets in the areolae.



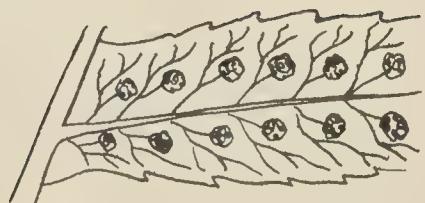
§4. *Eupolypodium*. Veins free; fronds pinnate; sori large, terminal or lateral, immersed, or on the surface.



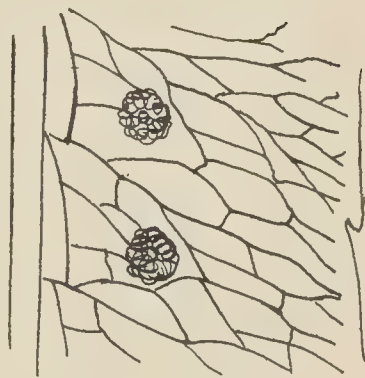
The Genera.

Polypodium

§5. *Goniophlebium*. Blume. Veins forked or costaeform, venules anastomosing angularly, except the lower exterior venule, which is free, forming ample areolae, each with a distinct, free, included veinlet; sori parallel with and near the costa, forming a double line each side, on the tip of the lower veinlet, or the free veinlet in the areolae; sporangia surrounded by paraphyses, some simply clavate, others ending in peltate scales; in some cases the whole frond is rough with peltate scales which are elongated on one side; similar scales elongated in two directions with intermediate teeth, accompanying the fruit.



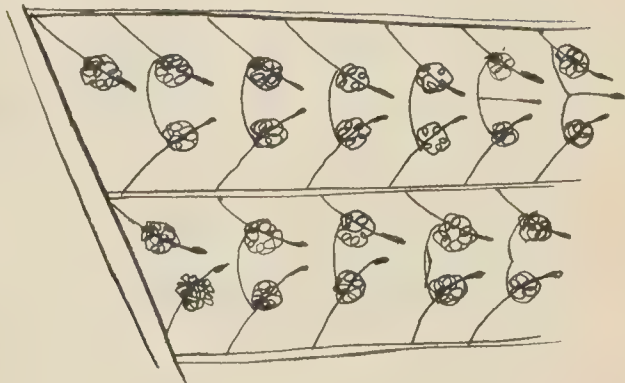
§6. *Phlebodium*. R.Br. Veins angularly or arcuately anastomosing, forming ample areolae, each with two or more conniving or transversely combined veinlets which are soriferous on their combined apices or line of junction; sori not at first covered with scales.



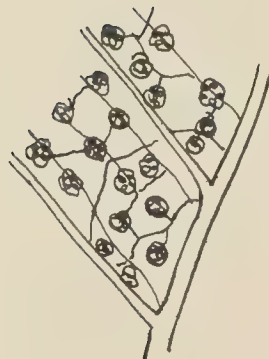
The Genera:

Polypodium

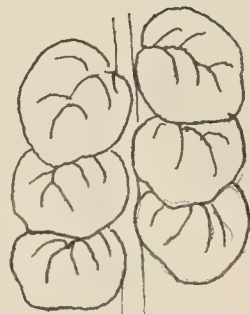
§7. *Campyloneuron*. Presl. Primary veins distinct from midrib to edge, connected by parallel, straight or curved, transverse veinlets; areolae similar, containing two or more sori, the free veinlets all directed towards the outer edge.



§8. *Phymatodes*. Presl. Veins mostly costaeform, parallel or flexuose; venulae compound anastomosing; sporangia on the angles or points of confluence of numerous veinlets; sori circular or oblong, transversely uniserial, or in one or two oblique rows between each pair of primary veins, or irregular; sori forming protuberances on the upper or superior side of the frond; frond smooth, thick.



Veins free, radiating; sori round, placed on the veins, remote from the edge, confluent, forming a large central sorus on each pinna; margins of pinna revolute, forming a common involucre. *Jamesonia* H. & G.



The Genera:

Sori marginal, at first roundish or oblong, soon confluent into a narrow band, without indusium, but sometimes covered at first by the reflexed edge of the frond; veins forked or pinnate; under side of frond sometimes covered with white farinaceous powder, sometimes densely tomentose or squamose - - - - *Notholaena*.

§1. *Eunotholaena*. Fronds not farinose beneath; scaly, hairy, or tomentose.

§2. *Cincinalus*. Desv. Fronds farinose beneath with white or yellow powder (some species naked).

Sori linear, at the end of the frond, close to the midrib on one or both sides, at length veiled by the contracted fertile frond. Small, grass-like, or rush-like, plants, the simplest in structure of all the ferns - - - - - *Monogramme*
Schkr.

§1. *Monogramme*.

§2. *Pleurogramme*.

The Genera:

Sori oblong or linear, following the course
of the veinlets, and, like them, simple,
forked, or pinnated, or variously anas-
tomosing -----

Gymnogramme

§1.

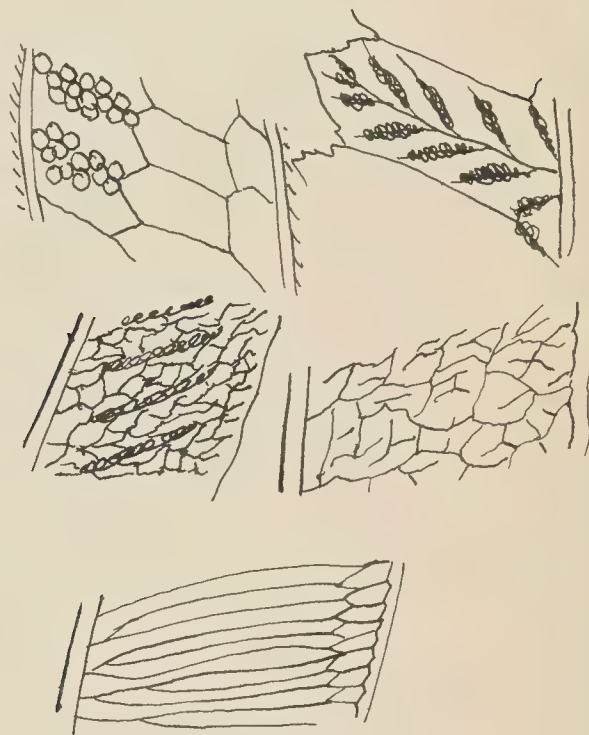
§2.

§3.

§4. Eugymnogramme. Veins free;
under surface not farinose.

§5. Ceropteris. Link. Fronds farinose below

§6. Selligra.



The Genera:

Fronde pinnate, about two feet long,
veins flabellately forked, lower venules
anastomosing angularly, forming a
costal row of oblique, cuneiform, areoles;
sori broad, continuous, or sub-interrupt-
ed, transverse, naked -----

Brainea, J. Sm.

Sori oblong or linear, occupying the con-
nivant transverse veinlets; fronds sim-
ple, or once-pinnate -----

Meniscium,
Schreb.

Sori carried along the veins, imperfectly
reticulated, sunken -----

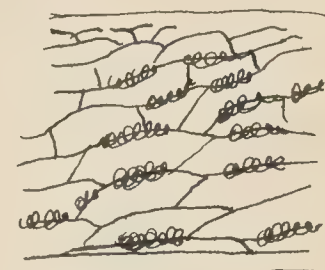
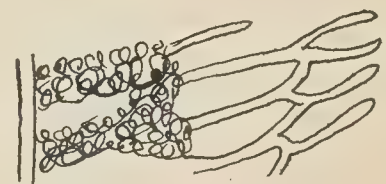
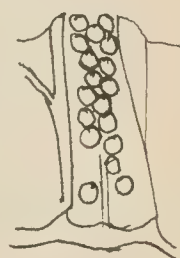
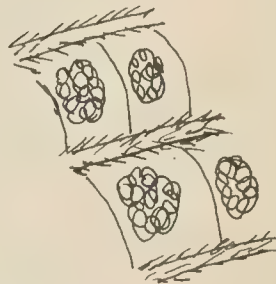
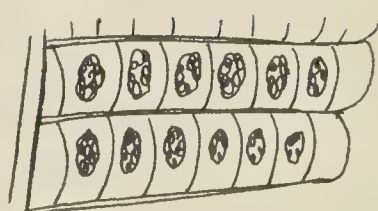
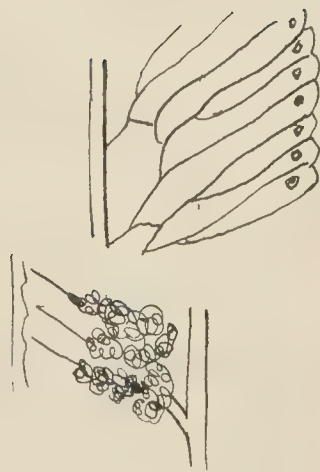
Antrophyum,
Kaulf.

Sori linear, but the line sometimes inter-
rupted, central, or sub-marginal; par-
allel with the margin; veins reticu-
late -----

Taenitis, Swz.

Sori marginal, continuous, linear, some-
times confined to the apex; veins ar-
tificate, with free veinlets in the
meshes -----

Drymoglossum



52. Anotium

The Genera:

Sori reticulated, following the veins,
 almost wholly covering the back of
 the fronds; veins reticulated; fronds
 simple, cordate, palmate, or pinnate. *Hemionitis*
Linnaeus

Sori continuous in 2-lipped marginal
 grooves, or in slightly intramarginal
 lines with the unaltered edge of the
 frond produced beyond and often rolled
 over them, but without special indusia;
 frond simple, linear, grass-like; veins
 free ----- *Vittaria*

§1.

§2. *Taenopsis*. J. Sm.

91

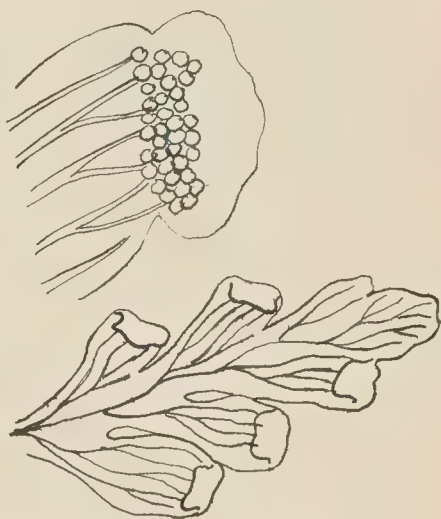
The Genera:

Sori usually numerous and distinct, marginal, short, covered by a reflexed, more or less altered margin of the frond, which bears the sporangia on its under side, from the approximated tips of free forking veins; midrib of the pinnules near the lower margin, or wanting - - - - - *Adiantum*. L.



91. *Euadiantum*.

Sori marginal, transversely oblong, occupying the apices of the lobes of the segments; involucre same shape as the sorus, formed of the reflexed margin of the frond, with which it coincides in texture, and covering the sorus; sori seated on the tips of from 2-4 converging veinlets - - - - - *Ochropteris* 15m.



Sori marginal, placed in the sinuses of the frond, more or less distinctly reniform, but often considerably elongated; involucre same shape as sorus and covering it, membranous in texture, formed from the reflexed margin; venation reticulate - - - - - *Lonchitis* Linn.



The Genera:

Sori marginal, placed usually in the sinuses of the frond, small, sub-globose, uniform, distinct; involucre same shape as the sori and covering it, membranous in texture formed of the reflexed margin. *Hypolepis*.



Sori sub-globose, distinct, terminal, or nearly so, on the veins, at first small and roundish, afterwards more or less confluent; involucre formed of the reflexed margin of the frond; roundish and distinct, or more or less confluent; veins free ----- *Cheilanthes* _{Swz}

§1. *Adiantopsis*. Fee. Involucre distinct, roundish, confined to the apex of a single veinlet.

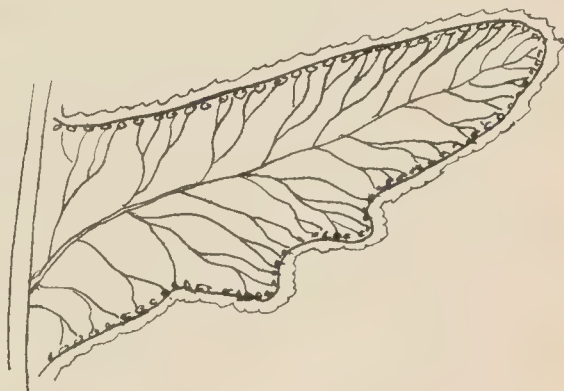
§2. *Eucheilanthes*. Involucres more or less confluent, extending over the apices of several veinlets, but not confluent all round the segment; segments mostly flat; not bead-like.



§3. *Physopteris*. Presl. Ultimate segments minute, bead-like; involucre usually continuous all round the margin; fronds bitripinnate, lower surface scaly, tomentose, or both.



§4. *Aleuritopsis*. R.Br. Involucres more or less confluent; fronds farinose below.



The Genera:

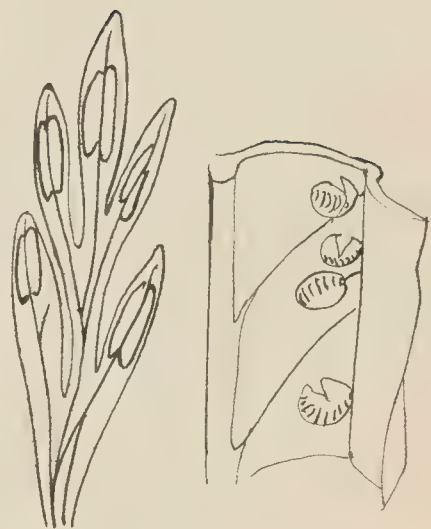
Sori terminal on the veins, sub-globose or oblong, not reaching beyond the branches of a single vein; involucre inserted distinctly within the margin, and separate from it, of the same shape as the sorus and pressed down upon it. -----

Cassabeera
Kaulf.



Sori short, linear, continuous eventually becoming confluent, and covering the whole disc between each pair of sori; indusium plane, the free margins of each pair, conniving over the midrib; and splitting open along the centre by a longitudinal suture; veins simple, direct, free, on their apices, combined by a transverse sporangiferous receptacle, which is formed in the axis of a linear, slightly intramarginal, indusium; fronds deltoid, elongate, acuminate, decou-
pound. -----

Onychium
Kaulf.



Sori linear, occupying the whole length of the changed, pod-like segments of the upper part of the frond; involucre same shape, rolled over, and quite concealing them. ---

Llavea Logas.



The Genera:

Sporangia on the back of and near the end of the veins; sori oblong or roundish, at length confluent, covering the back of the pinnule; involucre continuous, formed of the membranous, somewhat altered margin of the pinnules, at first reflexed along the two sides and meeting at the midrib, opening out flat.-----

Cryptogramme
R.Br.



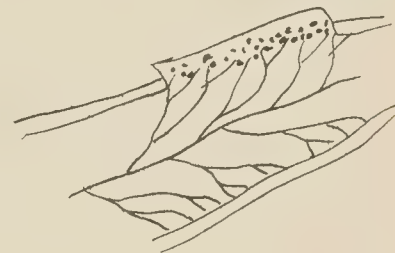
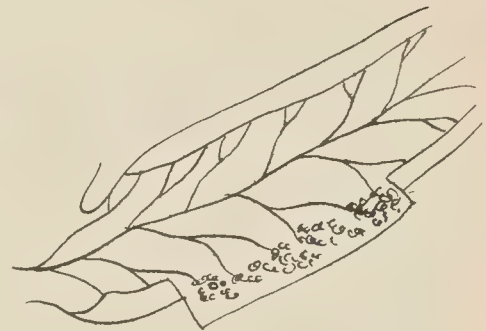
Sori intra-marginal, terminal on the veins, at first dot-like or decurrent, on the upper side of the veins, at length confluent, laterally, forming a marginal line; involucre commonly broad and membranous, formed of the reflexed margin of the fertile segment. Sterile and fertile fronds usually (or nearly) similar.-----

Pellaea
Link.

§1. *Cheilopteron*. Fee. Texture herbaceous or subcoriaceous; veins clearly visible; involucre broad, in most rolled over the sori until maturity.

§2. *Allosorus*. Baker. Texture coriaceous, the veins mostly not perceptible; involucre broad, conspicuous. Pinnules or segments obtuse, or barely acute.

§3. *Platyloma*. J.Sm. Texture coriaceous, the veins usually hidden; ultimate segments broad and flat; involucre so narrow as soon to be hidden by the fruit.



The Genera:

Sori marginal, linear, continuous, occupying a slender, filiform receptacle which connects the tips of the free veinlets; involucre membranous, delicate, whitish, formed of the reflexed margin of the frond; midribs of the pinnules central ----- Pteris.

§1. *Eupteris*. Veins free, stipes tufted, involucre single.

§2. *Paesia*. St. Hilaire. Veins free; involucre more or less double.

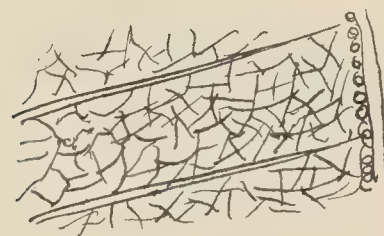
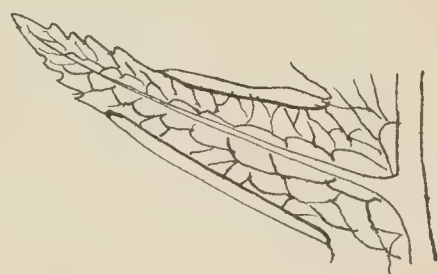
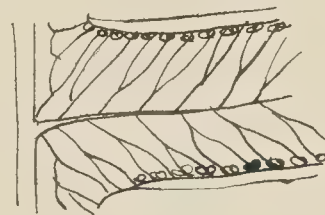
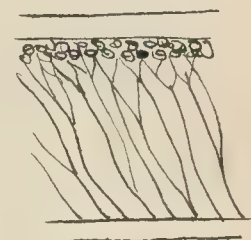
§3. *Heterophlebium*.

§4. *Campteria*.

§5.

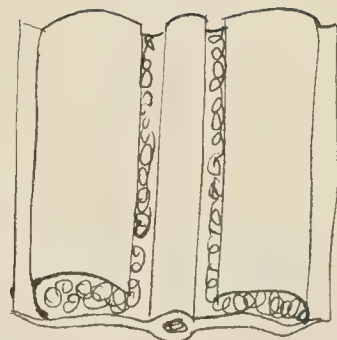
§6. *Lythrochidia*.

§7. *Amphiblectra*.

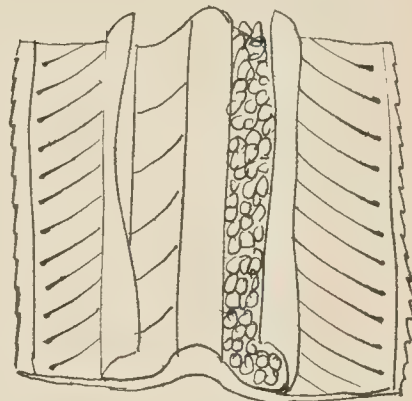


The Genera:

Sori in a continuous band next the midrib of the contracted pinnæ of the fertile frond, covered till maturity by an elongated indusium, either formed of the recurved and altered margin of the pinnæ, or sub-marginal and parallel to the margin; veins of sterile frond oblique to the midrib, simple or forked, free; fronds mostly elongated, dimorphous, the sterile foliaceous, the fertile much contracted. *Lomaria* Willd.



Sori linear, elongated, more or less confluent, continuous, or nearly so, parallel with the midrib, usually contiguous to it; indusium continuous, distinct from edge of frond, membranous, open towards the costa; veins free--- *Blechnum*.



Sori in a continuous line close to midrib on both sides, placed on an elevated receptacle; involucre narrow, subcoriaceous, at first wrapped over the sorus, afterwards spreading; veins forming a series of costal areolæ. Caudex 3°-4° high, arborescent.----- *Sadleria* Kaulf.



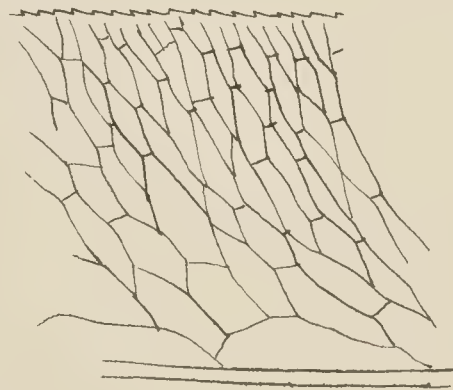
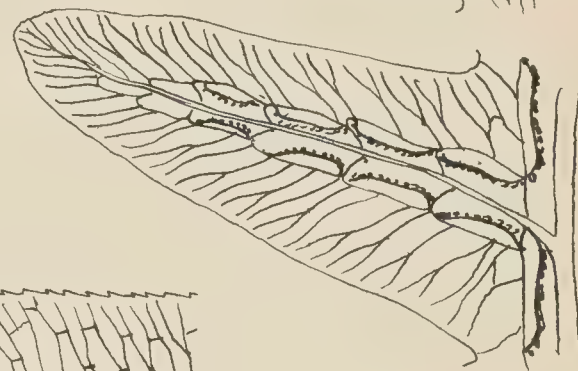
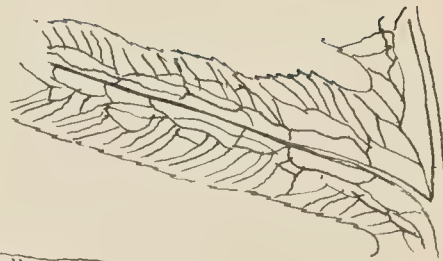
The Genera:

Sori oblong or linear, sunk in cavities in the frond, arranged in a chain-like row parallel to the midribs and near them; indusium fixed by its outer margin to the fruitful veinlet, covering the cavity like a lid; veins more or less reticulated Woodwardia

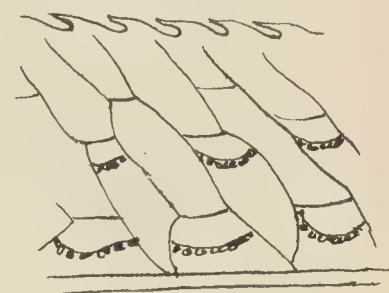
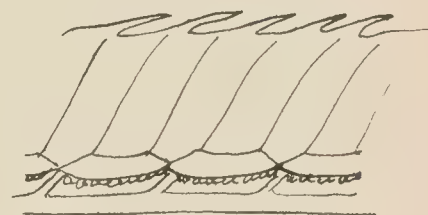
§1. Euwoodwardia. Fronds uniform, veins forming at least one series of areolae between the sori and the margins.

§2. Anchistea. Presl. Frond uniform, veins free between the sori and the margins.

§3. Lorinseria. Presl. Fronds dimorphous, veins everywhere forming areolae.



Sori oblong, short, straight or arcuated, parallel to costa, or transverse veins, transverse-ly uniserial or biserial; indusium flat, of same form as sori; fronds pinnatifid or pinnate; margins spinulose ----- Doodia. R.Br.



The Genera:

Sori dorsal, oblong or linear, oblique, separate;
indusium straight, or rarely curved, fixed by
one margin to the veinlet, opening at the
other towards the midrib - sometimes double. *Asplenium* L.

§1. Veins free -

§2. *Euasplenium*. Veins branched or simple,
free; indusium straight or slightly curved,
attached to the upper side of a vein.

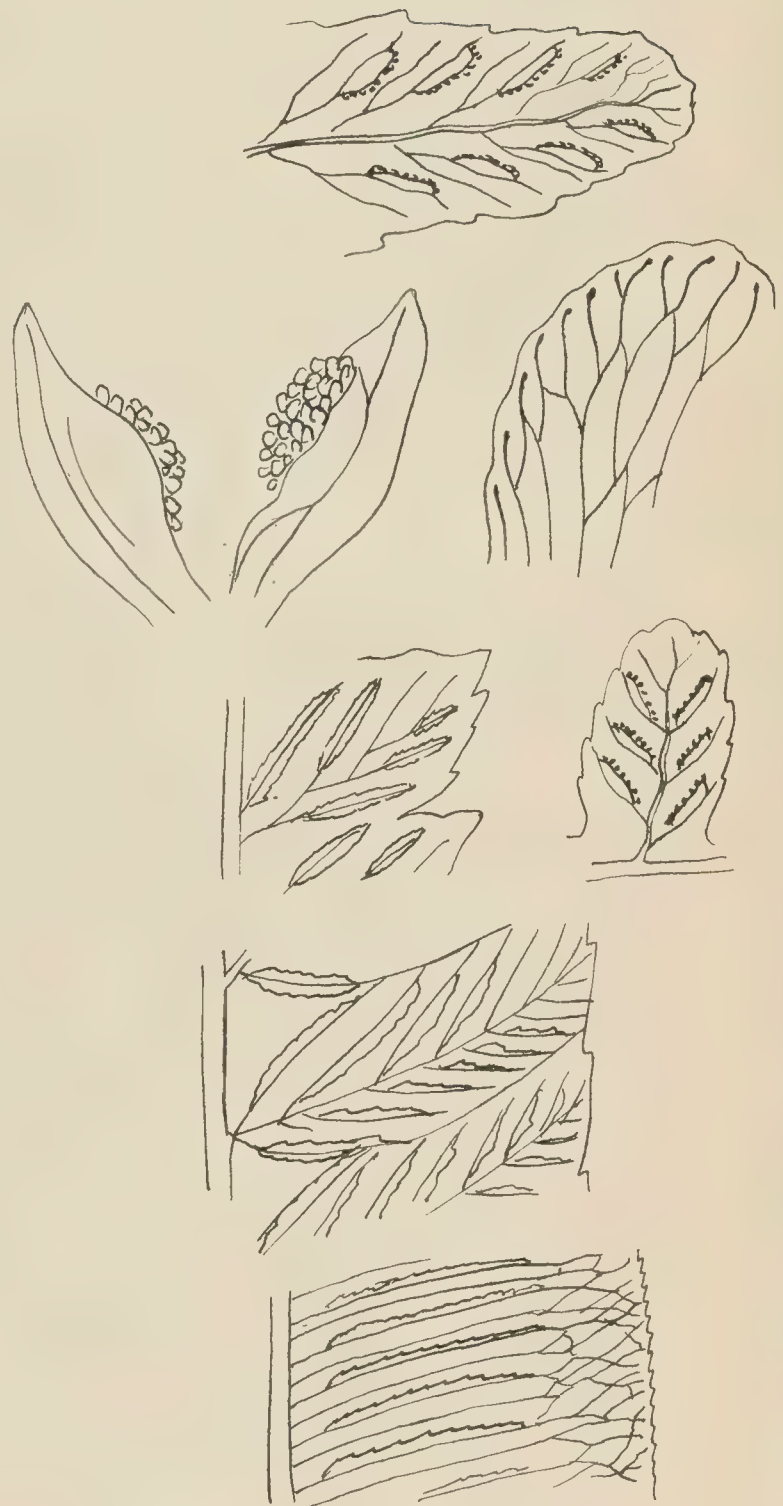
§3. *Dared*.

§4.

§5. *Diplazium*. Sori bilateral or double;
indusium opening in opposite directions

§6. *Anisogonum*. The pinnate veinlets form-
ing little arches.

§7. *Hemidictyon*. Exterior margin of the
reticulated venation combined by a con-
tinuous vein parallel and close to the
margin.

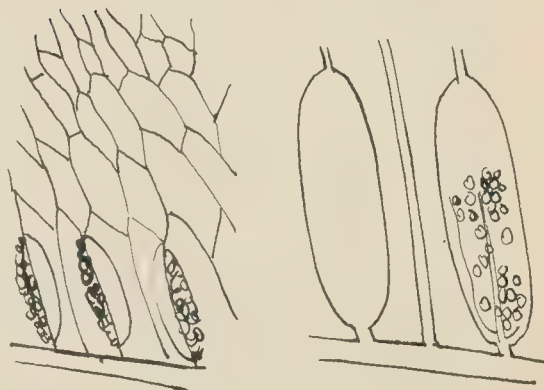


The Genera:

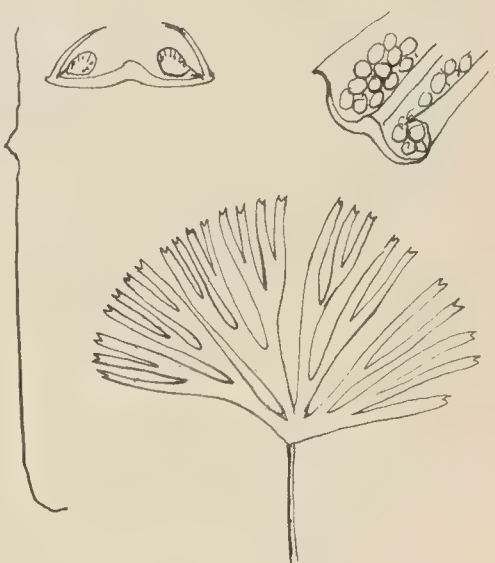
Sori more or less curved, sometimes horse-shoe-shaped, often crossing to the outer or lower side of the printing veinlet; veins free . . . *Attyrium* Roth.



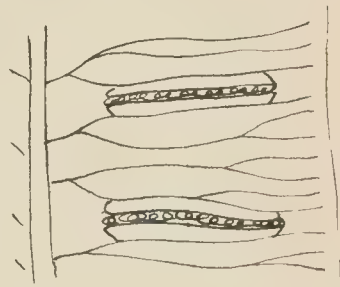
Sori dorsal, linear-oblong, attached to the primary veins; indusium vaulted, same shape as the sorus, quite enclosing it, bursting in an irregular line down to the center; veins reticulated . . . *Allantodia* Wall.



Sori linear-elongated, sub-marginal; indusia same shape as sorus, folded over it, placed one on each side of the narrow segments of the frond, opening towards the midrib . . . *Actiniopteris* Link.



Sori linear, elongated, almost at right angles to the midveins, contiguous by twos, one on the upper side of one vein, and the next on the lower side of the next superior veinlet, thus appearing to have a double indusium opening in the middle . . . *Scolopendrium*



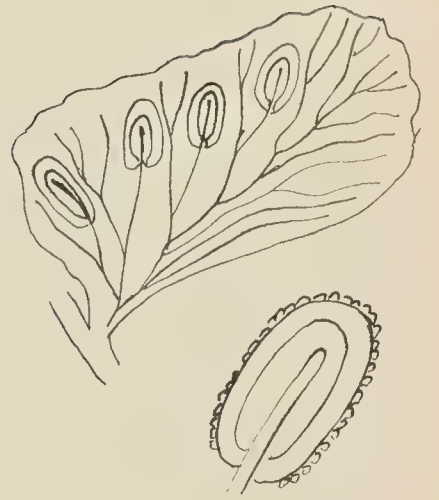
Sori oblong or linear, borne partly on the veins parallel to the midrib, partly on oblique veinlets, those next the midrib single, the outer ones inclined to approximate in pairs, or to become confluent at their ends, so forming crooked lines . . . *Camptosorus*



The Genera:

Sori elliptical, uniserial, situated on the apex of a venule; indusium oblong, attached along the center longitudinally, veins forked and radiating, venules direct and free, the exterior one fertile; fronds bipinnate, caudex erect and arborescent, attaining a height of above 2 feet, bearing from its crown large fronds 3°-5° long -----

Didymochlaena
Desv.



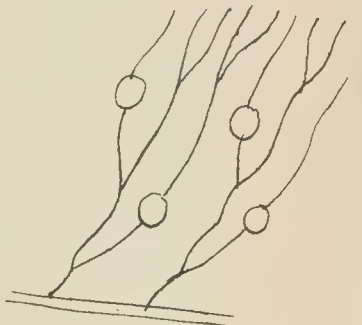
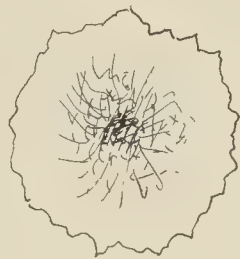
Sori round, rather small, apparently naked, borne on the back of and below the apex of the veins; stipes continuous with the rhizome. Veins free in our species -----

Phegopteris
Fee



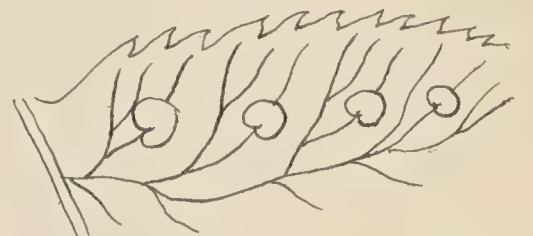
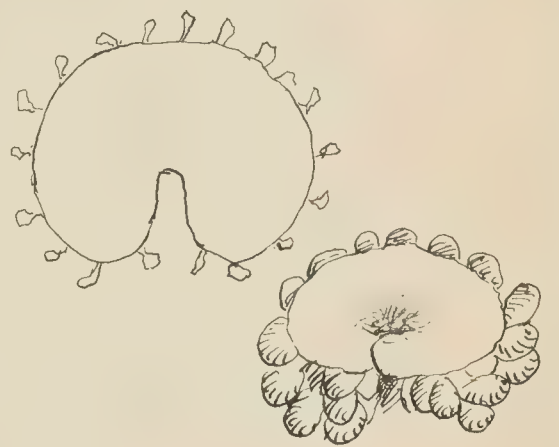
Sori round, borne on the back, or rarely at the apex of a vein; indusium flat or flattish, orbicular, with a sinus, fixed at the center, opening all around the margin; stipes continuous with the rhizoma -----

Aspidium. Swz.



Sori circular, a row on either side of the veins, sporangia medial; indusia mostly cordato-reniform (rarely orbicular), with a narrow sinus, fastened at the sinus; veins pinnate, costaeform, the lowest pair or pairs of venules fertile, and regularly anastomosing, their points of meeting combined by an excurrent anastomosing sterile veinlet; fronds simple or pinnate; pinnae entire, serrate, or sinuously pinnatifid -----

Nephrodium. Schott.



The Genera:

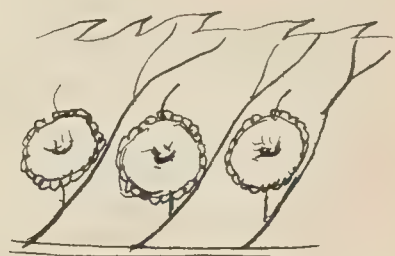
Nephrodium.

§ a. *Lastred*. Veins distinct.

§ b. *Sagenia*. Veinlets compoundly anastomosing - no free veinlets.

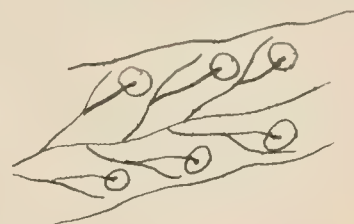
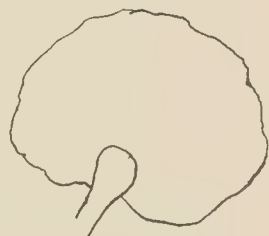
§ c. *Pleocnemia*. Differs mostly in its giant habit.

Sporangia usually medial, rarely terminal, sori circular, indusium orbicular, entire, fixed by the depressed center (peltate), veins pinnately-forked, venules direct, free, the lower exterior one or more fertile; fronds simple, pinnate, or bi-tri-pinnate, the serrate edges of the of the frond rigidly spinulose; pinnae and pinnules usually auricled on the upper side at the base. *Polystichum* Roth.



§ . *Cyrtomium*. Sori medial.

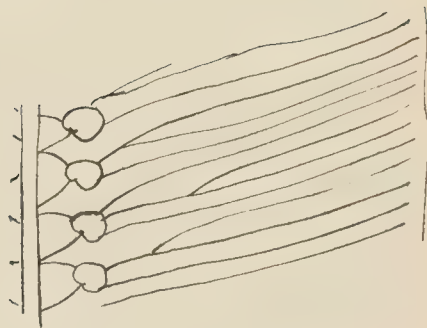
Sori round, from the apex of the upper branch of a vein, usually near the margin; indusium reniform or roundish, fixed at the sinus, or auricled base, opening toward margin of frond. *Nephrolepis*



The Genera:

Sori circular, transversely uniserial, costal or irregular, indusium reniform, veins simple, or forked; fronds simple, entire, lanceolate, stipitate; rhizome scandent or creeping -----

Oleandra
Cavanilles



Sori oblong-reniform, transversely uniserial, on the upper portion of a veinlet in the costal areoles; indusium exceedingly large, lateral, oblong-reniform; veins forked, venules anastomosing and reticulate; sterile and fertile fronds simple, different, - fertile frond contracted -----

Fadyenia
Hooker



Sori roundish, on the back of the veins; indusium delicate, hoodlike or arched, attached by a broad base on the inner side, partly under the sorus, early opening, free at the other side, usually reflexed or thrown back, as the sporangia ripen, or withering away; veins free -----

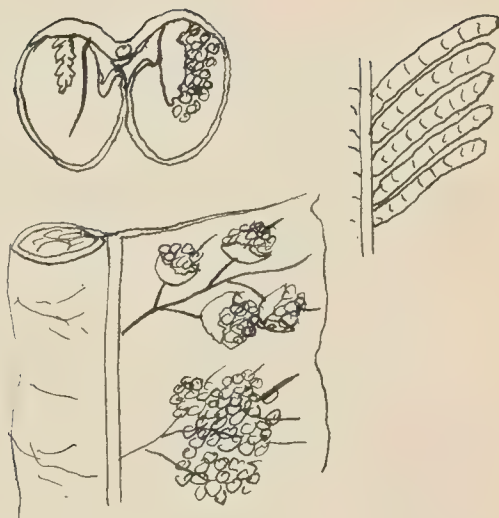
Cystopteris



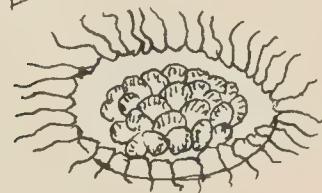
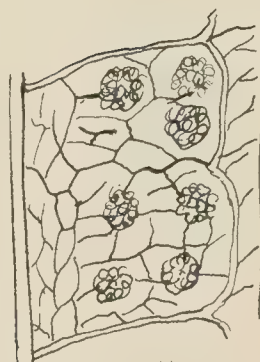
Sori round, on the back of the veins, concealed by the revolute margins of the fertile frond; indusium very thin, membranous, hemispherical or hood-like, fixed at the inferior side of the sorus; fronds dimorphic; veins of sterile frond copiously anastomosing -----

Onoclea. L



*Struthiopteris*

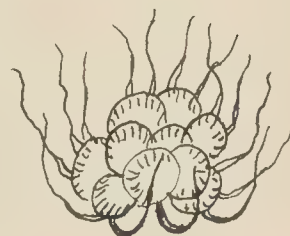
Sori circular, irregular, or uniserial on either side of the primary veins, formed at the points of confluence of numerous veinlets; indusium perfect cup-shaped, very obscure, partly buried under the sorus; veinlets anastomosing; fronds stipitate, simple, entire, or trilobate; rhizome creeping.

*Hypoderris*
R.Br.

Sori rounded, on the back of simply-forked free veins; indusium inferior, thin, and often evanescent, either small and open, or early bursting at the top into irregular pieces or lobes.

Woodsia

Sl. *Euwoodsia*. Indusium minute or evanescent, open flat from an early stage, concealed under the sorus, its margin cleft into slender hairs or cilia.



The Genera:

Woodsia

§2. *Hypopeltis*, Torrey. Indusium conspicuous, at first enclosing the sporangia, but early opening at the top and splitting into several spreading and jagged lobes;

Sori globose, on the back of a vein or veinlet; receptacle large, involucre inferior, globose, coriaceous, stipitate, at first enclosing the whole sorus, at length bursting vertically into two spreading lobes or tips; tips of veins clavate and glandular -----

Sphaeropteris
Wall.

Sori terminal, and vertical; indusium more or less tubular; veins forked; veinlets free -- *Davallia*, Swz.

§1. *Humata*. Indusium coriaceous, veinlets thickened upwards -----

§2. *Leucostegia*. Sori scattered on the sinuses of the laciniae; indusium scarious.

§3.

§4. *Eudavallia*. Indusium tubular.

§5. *Microlepia*. Sori without accessory indusia.

§6. *Loxoscaphe*.



The Genera:

Sori linear, marginal, or sub-marginal, mostly continuous, placed at the apex of and uniting two or more veins; indusium double, opening outwardly, the inner valve membranaceous, the outer formed of the more or less changed margin of the frond: -----

Lindsaya
Dryand.

Sori linear, continuous, forming an intra-marginal belt on either edge of the frond; indusium linear, marginal, continuous, opening from the upper surface of the frond; veins compoundly anastomosing, internal, with free veinlets in the areolae; fronds enciform, simple, fertile one contracted ---

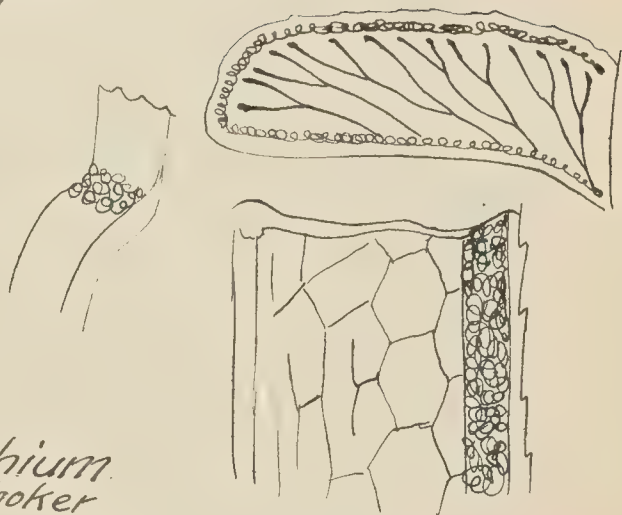
Dictyoxiphium
Hooker

Sori small, globular, marginal or intra-marginal, sporangia borne in an elevated globular receptacle enclosed in a membranous, cup-shaped, indusium, which is open at the top, partly adherent to a reflexed toothlet of the frond -----

Dicksonia
L'Her

51. *Cibotium*. Cup with nearly equal valves.

52.

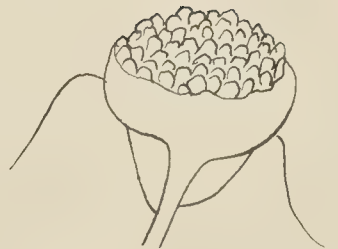


The Genera:

Dicksonia.

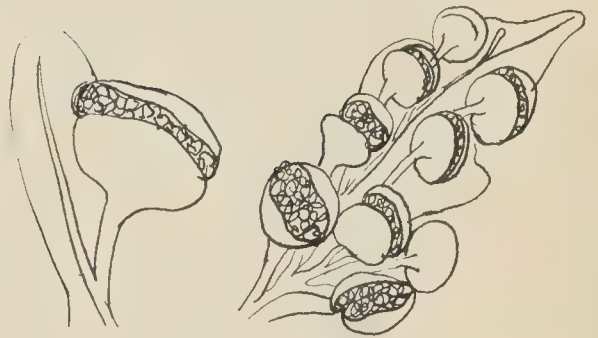
§3.

§4. Patania. Indusia saucer-shaped, covering only base of sorus, the true and false indusia being completely connate.



§5. Sitolobium. Texture delicate, rhizome creeping.

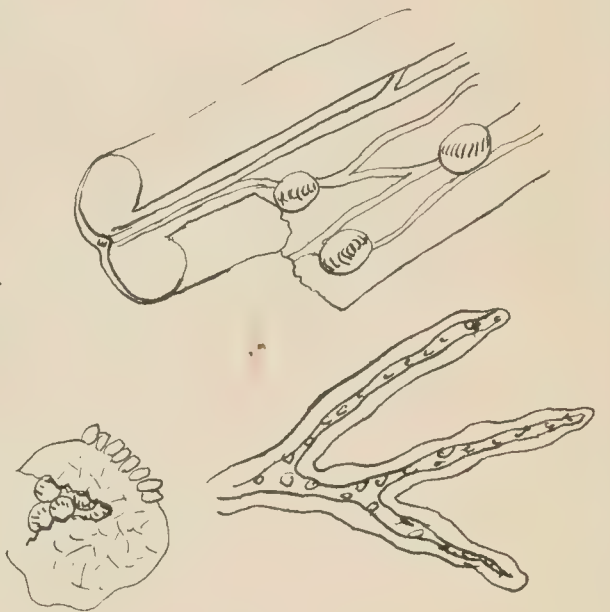
Indusium cup-shaped, to which the false indusium forms a sort of lid - - - - - Balantium



Sori terminal, exserted, indusium conniving, forming a calyciform, pedicellate, vertical cyst; veins pinnate with free venules; fronds bipinnatifid - - - - - Deparia H. & G.



Sori placed on two or three veins which run down the frond longitudinally nearly parallel with both edge and midrib; sporangia scattered on the receptacles, sessile, globose; indusia formed of the reflexed margin of the frond, those of the opposite sides meeting at the midrib - - - - - Ceratopteris



The Genera:

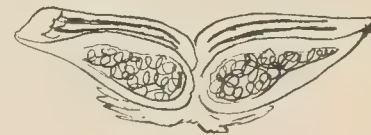
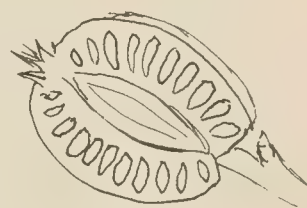
sporangia confluent only at the base, obovate, in a row each side of a linear receptacle, projecting from the vein, forming a narrow ellipse; sori oblong, biserial, opening on the inner side, forming a broad marginal row; veins simple, forked; fronds erect, arboreus, rising from two fleshy appendages -----

Angiapteris
Hoffm.



sori biserial at the ends of the veins, just within the margin, each consisting of two opposite parallel plates with convex back and plane faces, the latter marked by vertical gashes opening into as many cells containing spores; The two rows of sporangia are at first combined into a common solid mass, but after a time this splits in the direction of the vein and becomes bivalvate; veins simple or forked; free; fronds erect, sub-arboreus, arising from between two fleshy appendages which, occasionally, have the character of abnormal fronds -----

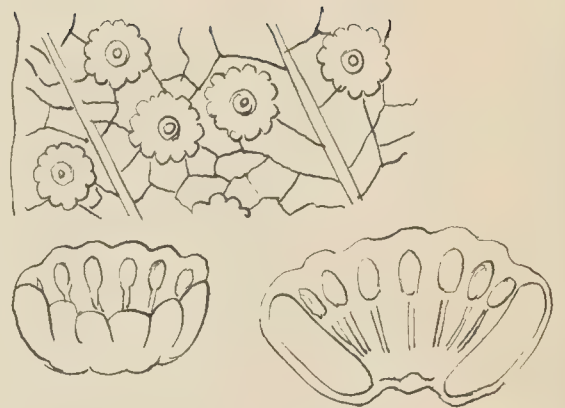
Marattia
Smith.



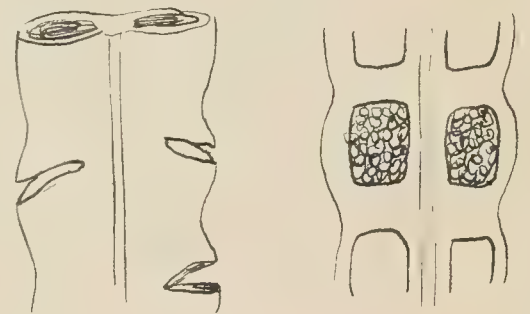
The Genera:

Sori sessile, in two rows, intimately combined with cellular tissue into a chambered mass, covering the whole underside of the pinnae, each chamber containing two sporangia; discharging the spores by round pores at the apex ----- *Danaea* Sm.

Capsules sessile, 10-15, quite concrete, in raised circular masses, which are hollow in the center, with oblong apertures on the inner face ----- *Kaulfussia* Blume.



Sporangia large, coriaceous, connate, coherent, in two ranks on the edges of a simple, or rarely forking, spike ----- *Ophioglossum*



§. *Rhizoglossum*. Consists of a few subulate leaves and a pedunculate spike of sporangia (similar to *Phylloglossum*).

Capsules in small crested clusters which form a long, loose spike ----- *Helminthostachys* Kaulf.

Sporangia naked, sessile, in double rows on the once-to thrice-pinnate fertile segment ----- *Botrychium* Swz.



Heterosporous Pteridophyta

Here two kinds of spore are produced, large ones, the macrospores, giving rise to the female element; and small ones, the microspores, producing the male element. The gametophyte never becomes separated from the spore, nor independent of it, but draws nutrition from it.

Rhizocarpeae

Salviniae

Salvinia

Azolla

Marsiliae

Marsilia

Pilularia

Lycopodiaceae

Articulata

Lycopodium

Imbricaria

Phylloglossum

Pilotum

Ligulateae

Selaginella

Isoetes

Rhizocarpaceae

Vernation straight or circinnate. Branching similar to the true ferns, never terminal nor axillary but exclusively from the basal part of submerged leaves, on the side facing the nearest aerial leaf. Roots like those of ferns. Stem composed of segments, some of which produce leaves, others form internodes. The leaves grow basifugally from an apical cell.

Salviniceae. Floating plants with two-ranked leaves, and elongated stem.

In *Salvinia*, the definite verticillate arrangement of the leaves commences at the fourth node, each whorl consisting of a submerged leaf on the ventral side, which branches and forms a tuft of long filaments hanging downwards in the water; the other two leaves are flat, spring from the dorsal side, and touch the water only with their ventral surfaces. These 3-leaved whorls alternate, forming two rows of ventral submerged, and four rows of dorsal aerial leaves. The submerged leaf is always the oldest. The sporangia are formed in stalked, capsule-like receptacles - sporocarps - on the submerged leaves. The stalks bear 1-several sporocarps. There may be 10-megasporangia, each containing one megaspore, in a sporocarp. Other sporocarps will contain a large number of microsporangia producing a great number of microspores.

Azolla.

The sporocarps are borne in pairs in the axils of the aerial leaves, and are of two sizes — the smaller bearing a single megaspore, the larger producing several microsporangia, and numerous microspores.

Marsileae.

Azolla.

The sporocarps are borne in pairs in the axils of the aerial leaves, and are of two sizes - the smaller bearing a single megaspore; the larger producing several microsporangia and numerous microspores.

Marsileae.

Rhizomes creeping in the mud; leaves filiform or 4-parted; sporangia in several-celled sporocarps, borne on, or near the base of the leaf stalks.

Marsilia.

The antherozoids are produced in the interior of the microspore; the female gametophyte only partly emerges from the megaspore. The roots are on the ventral side of the stem in strict acropetal succession, the youngest near the apex. The leaves rise in two alternating rows on the dorsal side of the stem. The first leaf is without a lamina, followed by a number with short stalks and laminas at first entire, but becoming more deeply 2-4-lobed, until there follows the normal leaves, circinnate, long-stalked, and a quaternate lamina. Sporocarps 1-6, on short pedicels, springing from the leaf-petiole. The sporocarps open by splitting into halves. Around the inner wall is a gelatinous ring which carries the sori on a series of short branches; absorbing water, the ring swells enormously, es-

escaping from the sporocarp. Each sorus contains both megasporangia and microsporangia, the former few in number, each with one megaspore.

Pilularia.

All the leaves are without a lamina. They are long, conical, filiform, and are rolled up spirally forwards. Sporocarps solitary, 2-4 chambered, each containing a single sorus~~es~~ bearing megasporangia at base, and microsporangia at the top. There is but one megaspore to each megasporangium, and numerous microspores in each microsporangium.

Lycopodiaceae.

The gametophyte fills the cavity of the spore, only that portion bearing the sex elements protruding. It is either wholly or partly underground, is without chlorophyll, but contains an associated fungus. The branching of the stem is either terminal and dichotomous, or there is no provision for branching. Leaves are always simple, with a single vein, terminated by a single point, sometimes ending in a fine awn, and are arranged on the stem in 4-16 rows. Sporangia are produced singly on the upper side of the leaves near the base,

the macrosporangia producing a few macrospores, the microsporangia a great number of microspores.

Articulata.

Moss-like plants, with elongated, much-branched stems covered with small leaves. Sporangia solitary in the axils of the leaves, often in special spikes, the lowermost sporangia in the spikelet producing macrospores only, and microspores above.

Lycopodium.

Gametophyte underground, yellowish-white, irregularly lobed, the antheridia and archegonia borne in grooves on the upper side. Roots are produced in acropetal succession, springing from the ventral side of the stem, forking when 3-4 cm long, the branching dichotomous. The leaves are simple, strongly developed, densely covering stems and branches. One species bears gemmae, or bulbils, products of the leaves. The phyllotaxy is spiral, the fractions becoming very complicated. The fertile leaves are uniform in size, and generally differ from the sterile: they form a quadrangular spike. A single sporangium is formed in the axil of a leaf.

Pinuspteris, has large, strong leaves. The solitary, elongated sporangium is on a stalk between two leaves.

Phylloglossum.Psilotum.

There are three sporangia seated round the end of a short branch, with two leaflets below them on the outer side. There are no roots. The rhizome puts out shoots which function as roots, and resemble them, but have no root-caps. The stem regularly dichotomises, remains slender, and grows very long. The leaves are small, rudimentary and scale-like. It usually grows on trees, rarely on fallen logs, or even on the earth, when it sends out shoots which produce buds or bubblets.

Ligulatas.Selaginella

Sporangia short-stalked, axillary, or on the upper surface at the base of leaves at the ends of branches, sometimes forming distinct, four-sided cones, the macrosporangia at the base, microsporangia above. The macrosporangia contain 2-8 macrospores. Stems and branches are densely covered with

small, strongly developed leaves, and dichotomize as well as the roots. There are true roots, in some species springing directly from the stem, in others from an intermediate organ, the Rhizophore, which may be transformed into a leafy shoot. The plants are terrestrial, rooting in mud.

Isoetes.

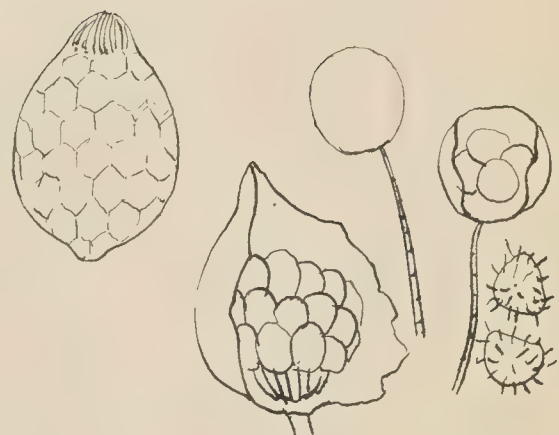
Has an extremely short, unbranched stem, growing scarcely at all in length, but very much in breadth, two or more lobed, the dichotomously branching roots growing from the depressions between the lobes. Top of the stem flat or depressed. Leaves long, sub-cylindrical above, triangular, or ~~triangular~~ expanded at the base, hollow, arranged spirally in dense rosettes (10-200) on the upper end of the stem. The fractions would run $\frac{3}{8}, \frac{5}{13}, \frac{8}{21}, \frac{13}{34}$ etc. The solitary sporangium is sessile in the fork of the leaf sheath. The outer leaves of the fertile rosette produce only macrosporangia containing a few macrospores; the microsporangia are borne on the more central leaves. The macrospores split open exposing the archegonia to fertilization. Some species, instead of sporangia, produce buds which separate and produce new plants.

The Genera:

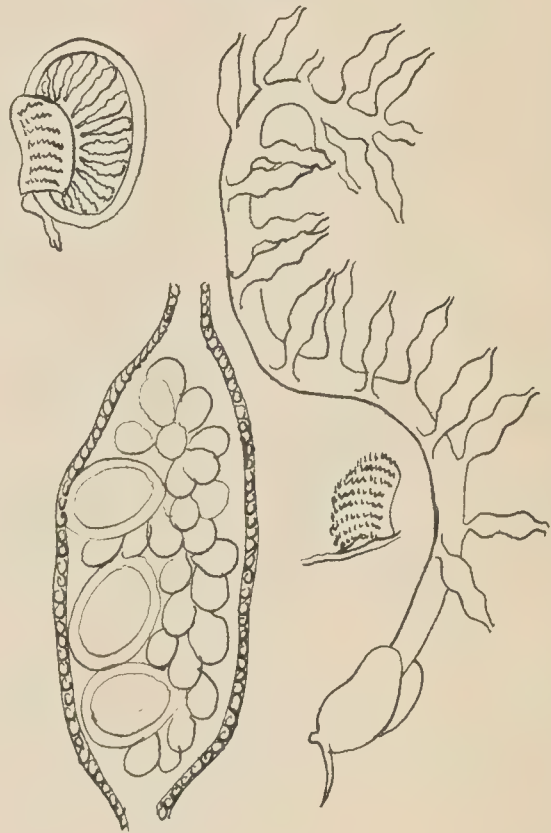
Sporocarps globose, depressed, 9-14 sulcate, membranous, arranged in clusters, 1-2 of each cluster containing 10 or more sessile macrosporangia, each containing few macrospores, the others containing numerous smaller, globose microsporangia with very numerous microspores. Floating annual plants with slender stems bearing rather broad, 2-ranked leaves. — *Salvinia*



Sporocarps of two kinds borne in the axils of the leaves, the smaller ovoid or acorn-shaped, containing a single macrospore at the base, the larger globose, producing many pedicelled sporangia, each containing several masses of microspores. Floating plants. — *Azolla*.



Sporocarps globular, with many partitions containing numerous short-stalked sporangia of two sorts, mixed, the larger containing a single oval or oblong spore, the smaller containing very many minute spores; Submerged, or immersed, aquatic plants, with whorls of four leaflets floating at the ends of long petioles. — *Marsilia*. L.



The Genera:

Spore cases globular, 4-celled, sessile; creeping aquatic plants, with slender, erect, quill-like leaves. ----- *Pilularia*



Spore-cases of one kind, coriaceous, flattened, usually kidney-shaped, borne in the axils of the leaves, either of the ordinary form, or modified and forming cone-like spikes ----- *Lycopodium*



Sporangia in clusters of 2-4, sunken in the ends of very short lateral branches and partly protected by two small leaves rising on either side; pinnae very broad; Plant often growing on the trunks of other ferns; pendulous ----- *Tmesipteris*



Phylloglossum

Sporangia as in *Tmesipteris*; trilocular; leaves setiform, ill-developed; stems erect, dichotomously branched, angular, triquetrous; Peculiarly modified branches take the place of true roots. Small, shrubby, exotic plants ----- *Psilotum*



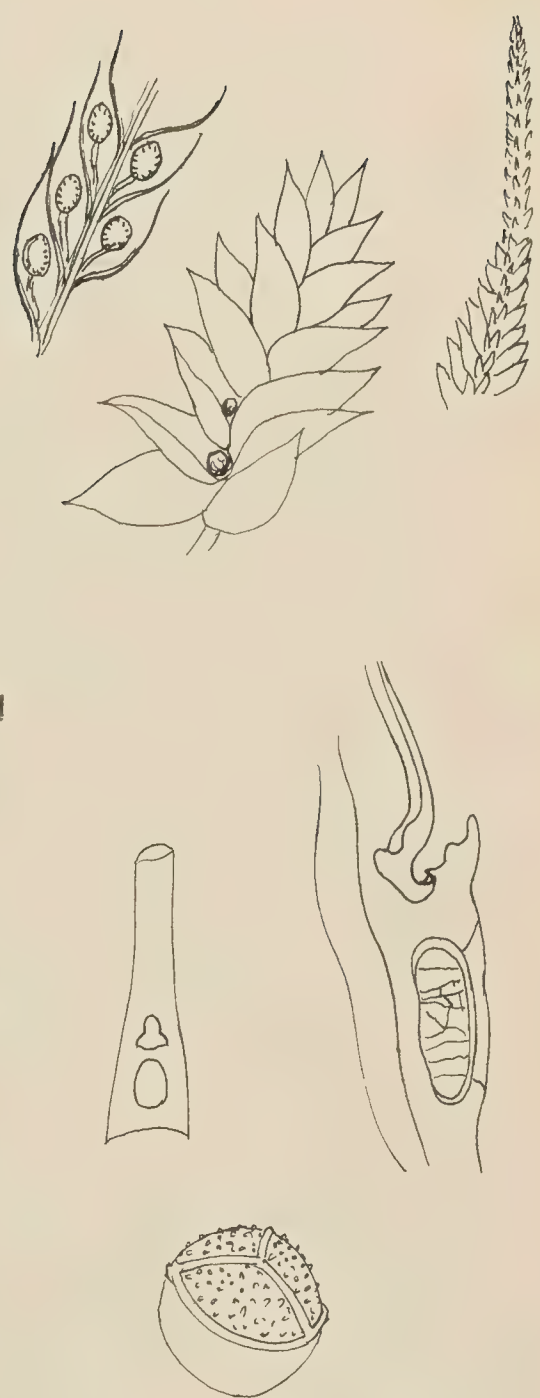
59
The Genera:

Fructification of two kinds; spore-cases very minute, oblong or globular, containing reddish or orange-colored spores, and terminal oosphoridia filled with 3-4, rarely 1-6, much larger, globose angular spores; latter either mixed with the former in the same axils, or solitary in the lower axils of the leafy, 4-ranked, sessile, spike;

Small, flat, moss-like plants ----- *Selaginella*

Sporangia sessile in the excavated bases of the leaves, orbicular, or ovoid, the sides more or less covered with a fold of the inner side of the leaf-base, the sporanges of the outer leaves usually contain spherical, mostly sculptured, macrospores; those of the inner leaves contain minute, powdery, usually oblong, microspores; Submerged, amphibious, or uliginous plants with a cluster of elongated, awl-shaped, leaves -----

Isoetes. L.



Written 1926

In our Marvel Cave Ozarks there are many beautiful ravines and hollows each having its quota of clear, cold springs of gurgling brook, and of mossy rocks and cliffs - of woodland beauty and charm.

It is an adventure of delight to explore each seductive path in turn, for each differs from the others, and wherever one may be, that becomes the loveliest spot of all.

Down in the dim moist, woodsy light of these deep gorges grow these lovely plants; the ferns, none of which but are common in some part of the United States.

Let us wander down one of these Hollows, following a little brook which purls and gambols among the rocks and boulders, leaping over mimic precipices, dropping into pigmy lakes, tinkling and chattering on its way.

Rocky cliffs rise on each side, great boulders and small lie loosely about; the forest throws a deep shade over all, and ferns are everywhere!

Covering the face of a rocky cliff with its dark-green, gracefully trailing

leaves, the Venus-hair fern, (Adiantum capillus-veneris) seems to deserve its reputation as the most beautiful fern in America. I really think that it should share honors with the American Maidenhair fern (Adiantum pedatum), which grows upright on the ground, the fingers of its bright green fronds spread out horizontally from a dark purple stem. Few ferns have been a greater favorite, or more often mentioned in song and verse.

The Bladder ferns and Woodsias are the darlings of our woods. They drape the mossy ledges with their bright green finely cut foliage, and also grow upright on the ground near springs, and in moist sheltered spots ~~and~~ in old rail fences. They are so much alike as to require an expert to name them correctly. The Woodsia (Woodsia obtusa), is the darkest in color, and not so delicate in texture as the Bladder fern (Cystopteris fragilis).

The Sensitive Fern (Onoclea sensibilis) loves to grow in the water and in the shade, when it may become coarse and very large, but it will grow in ordinary

soil, or even in dry places with little shade, when of course, it is very small. It is rare with us, tho common enough elsewhere.

The Purple Cliff-brake and the Rock Aspleniums, are as characteristic of the country as are its rocks. Everywhere, anywhere that a fern can grow—on hill-sides in stony ground, in crevices of rocks, on ledges, sometimes very much exposed—you wonder how they ever get moisture enough to grow at all—but they are far more luxuriant where there is ample moisture and shade.

The Rock Aspleniums, or Spleenworts, are very striking ferns. The Ebony Spleenwort (Asplenium ebenenum), is the largest. Its fertile fronds are tall and stiff, dark green, with dark stems. The tapering leaflets are so regularly alternate as to give the leaf a zig-zag appearance. The sterile leaves are small, bright green and form a rosette close to the ground.

In the Little Ebony Spleenwort, (Asplenium parvulum), all the leaves are alike in size, form and color (dark green), stiff and upstanding, the narrow leaflets de-

flexed. It is not so tall as the other, the leaves more numerous and closer together in the crown.

The Maidenhair Spleenwort, (Asplenium trichomanes), is a much handsomer plant, its daintily curved leaves long and slender and brighter green. It loves to grow on some mossy ledge near the water. The leaves of these rock aspleniums grow in crowns or clusters, often ten or more together. The stems persist long after the green blades or pinnae are shed.

But this Purple Cliff-brake, (Pellaea atropurpurea), is really the Ozark fern, adapting itself to every condition of habitat and environment. It is at its best in this moist, shady glen, growing in the crevices of the rocks, but you may find it on cliffs or boulders far removed from water, and in the most exposed situations. The great variation in the division of its leaves, adds to its interest.

In the moist bottoms where there is soil enough, grows the Grape fern (Botrychium virginianum), its large triangle of tender green as beautifully cut as a piece of fine lace. Like Maidenhair and Onoclea

it spreads its leaves horizontally, as tho to look upwards to the sky.

The Oak fern (Phegopteris hexagonopteris), is a rather large fern, bright green, and delicate in texture, tho not as finely cut and lace-like as the bladder-ferns.

This is one of the ferns which must have the shade.

All the ferns are intolerant of the presence of stock, and this one, among others, even of the hogsmell!

The Christmas fern (Nephrodium acrostichoides), whose leaves are evergreen and last thru even the severest winters, is one of our commonest ferns. It is a splendid, showy plant, with stately bright green leaves, of which there is often a large number growing in a crown. It grows on well-drained banks in the shade, and does not demand so moist an atmosphere as most other ferns do.

Covering the top of a great boulder here, is the Gray Polypody (Polypodium incanum), a small fern, and our rarest. It is very common south, on trees, stone walls, even on the roofs of old houses. Every time I come to this ravine, I experience again all the thrills of a new discovery

which I felt when I found this beautiful thing. It was very small then—just a few leaves, the largest not two inches long—there are hundreds of them now, many 6-8 inches long.

And just such thrills with a shout was mine when I found the Adders tongue (Ophioglossum engelmannii) at that time, one of the rarest ferns in the United States! There are still but a few places where it can be found in numbers, but in our Ozarks it occurs in groups of hundreds!—on the glades, creek bottoms, high up on the ridges in the "gravel" or on earth covered ledges; almost anywhere, almost any time, especially during, or following rainy seasons. My record shows that it was with us 10 months of the year.

It has a bright green leaf, elliptical, ending in a sharp point. The fertile portion is like the tail of a rattlesnake, carried on a long slender green stem, which branches from the lower end of the green blade.

It has the habit of "hiding" out, occasionally and disappearing for a while from its old quarters; it also

will appear quite unexpectedly in places where it has never been seen before.

Covering the top and sides of some of these boulders and rocks with a dense mat of green is the curious and pretty little Walking fern (Camptosorus rhizophyllus). The tip and sometimes the basal lobes of the leaf become very long and attenuated—almost like stolons, bearing a bud at the end. This bud develops into a plant, which may also produce other plants in the same manner. Sometimes there will be a series of these before the connecting leaves are broken—a green chain of ferns.

While most of our ferns demand at least a modicum of moisture and shade, there are two which seem to avoid these conditions and prefer to grow in the driest most exposed places.

Both are quite small, gray-green and finely divided, their leaves arranged in a compact rosette. They grow in the hollows of a certain kind of rock, and apparently obtain all their moisture from the air, as they are protected from the rains. In dry times the leaves curl up tightly, unrolling only when the air is moist again.

The Cloak-fern (Notholaena dealbata), is covered on the back with a fine white resinous powder; while the Rusty Lip-fern (Cheilanthes lanuginosa), has a heavy coating of light-brown hairs. These coverings afford protection to the sporangia and serve to prevent undue evaporation.

The Bracken (Pteris aquilina) is very common all over the world, and is probably the first fern to receive a name.

It is a rank weed in many places, and is the most noted in song and story. It also has magic powers ascribed to it. It is very large and coarse, yet not un-beautiful, especially in large masses, in some parts of the woods and hollows. It may be anywhere from two to ten feet high — not over four feet in our region. The leaves are triangular of a lively green, changing in autumn to shades of yellows and browns, and the texture to horny.

Poking around among the mosses and lichens you find a whole nest of baby ferns, and get one of the many surprises that a study of the fern's life holds for him who becomes intrigued with that absorbing and fascinating

subject. And you sit on a mossy
rock and dream dreams you cannot
put into words.

And when you wander back
up the hill, you feel as tho you
had just returned from other planet
and had tasted a new and wonder-
ful experience.

So much for the ferns in their native haunts. For your garden there are a few which may be transplanted from the wilds with some measure of success, if care is observed to take ample roots and soil with the roots and not let them get dry. Then give them the same conditions as they had in their native home. Give them a proper shaded spot, and a moist ~~stead~~ atmosphere, and success is yours. Put the plants no deeper in the ground than they were in their natural home. Moist ferns prefer a well-drained soil, and a moist atmosphere.

The Woodsias and Bladder ferns will be quite satisfactory; the Ebony spleenwort, the Maidenhair; the Oak fern and the Christmas ferns will do well and are really lovely. The Eagle fern will just what you want for a mass effect in some spot which has become unmanageable. If you have a wet spot Onoclea will thrive in it. The florists have other hardy sorts.

A proper soil would be - good garden soil $\frac{1}{2}$, clean sand $\frac{1}{4}$, wood's earth or rotted leaf mold $\frac{1}{4}$; mulch in the fall with tree leaves and a sprinkling of hydrated lime. Use no manure whatsoever.

